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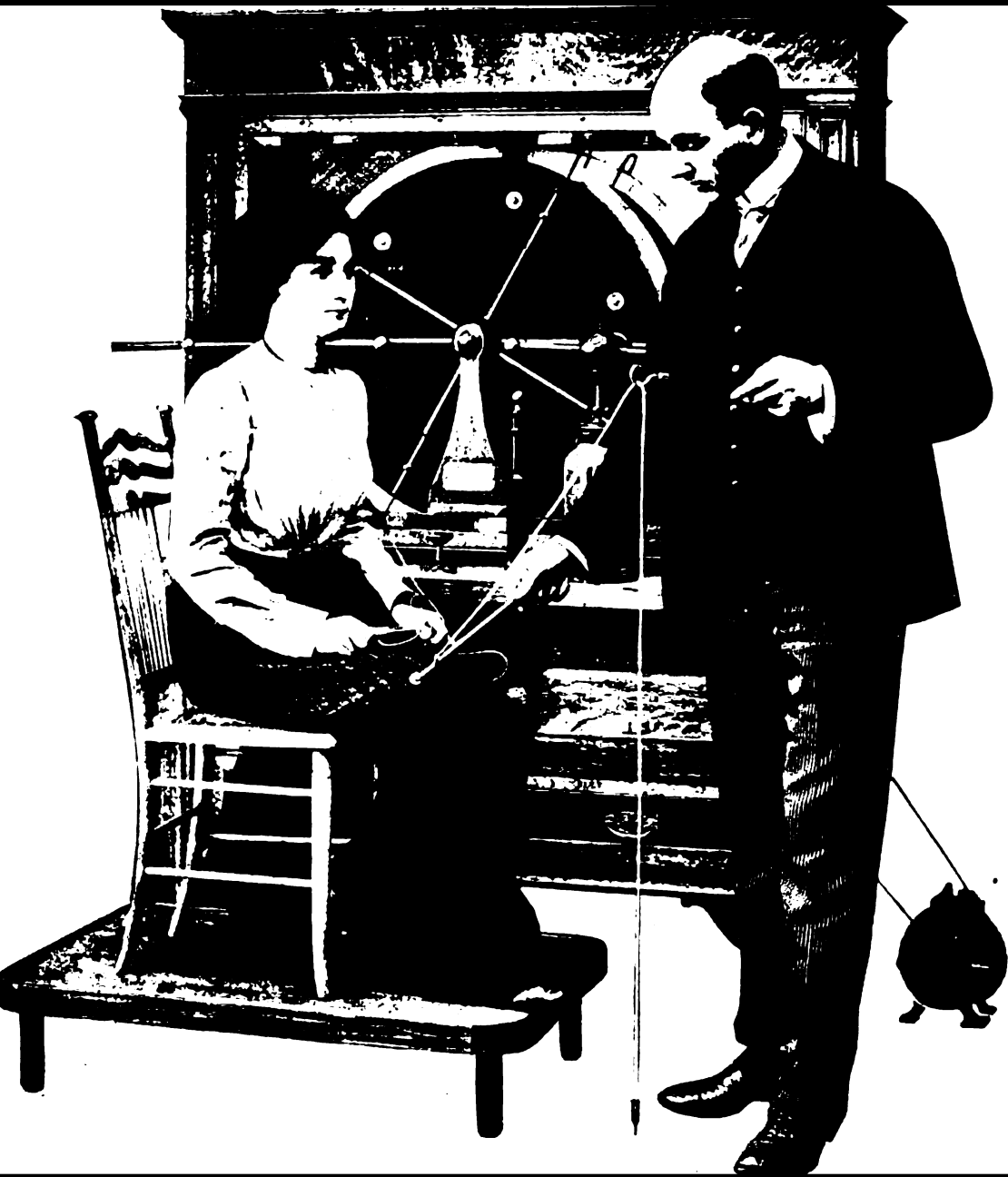
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# INTERNATIONAL CLINICS

## A QUARTERLY

OF  
ILLUSTRATED CLINICAL LECTURES AND  
ESPECIALLY PREPARED ORIGINAL ARTICLES  
ON  
TREATMENT, MEDICINE, SURGERY, NEUROLOGY, PEDIAT-  
RICS, OBSTETRICS, GYNECOLOGY, ORTHOPEDICS,  
PATHOLOGY, DERMATOLOGY, OPHTHALMOLOGY,  
OTOLOGY, RHINOLOGY, LARYNGOLOGY,  
HYGIENE, AND OTHER TOPICS OF INTEREST  
TO STUDENTS AND PRACTITIONERS

BY LEADING MEMBERS OF THE MEDICAL PROFESSION  
THROUGHOUT THE WORLD

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# Treatment

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## ELECTROTHERAPEUTICS

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THE student of electrotherapeutics should be familiar with the fundamental laws of electricity to a certain extent. Although this phase of the subject will be treated in a somewhat superficial manner, the physics of electricity will be gone into sufficiently to give a clear idea of the mechanism of batteries, the qualities of the current which each kind of battery generates, the physiologic action of the different currents, and the method of applying electricity to the human subject diagnostically and therapeutically.

Electricity was known to the ancients, and, as long as twenty-five centuries ago, Thales of Miletus discovered that when electron, or amber, was rubbed it acquired the property of attracting light articles. Theophrastus and Pliny later observed the same phenomenon, but it was not until the seventeenth century, when Gilbert, an Englishman, studied and described the properties of electron, that much was known about electricity as a science.

Guericke, in 1663, invented an instrument to develop static electricity. It consisted of a globe of sulphur which revolved on an axle while a cloth was applied to the sulphur by the hand of the operator. Glass was substituted for the sulphur a century later by Hawkesbee.

The Leyden jar was invented by Professor Musschenbroek, and was used in treating paralytics and the deaf and dumb.

But modern electricity received its greatest impetus from Franklin, who, in the eighteenth century, explained the phenomena of the Leyden jar and recognized the nature of lightning.



Galvanism was discovered by Galvani in 1790, though he did not understand its origin. This was reserved for Volta, an Italian, who, in 1800, described the "voltaic pile," which was composed of alternate sheets of zinc and copper separated by pieces of wet cloth.

We are indebted to the illustrious Ampere, Davy, Oersted and Faraday for many additions to our knowledge of the subject. Oersted, in the early part of the nineteenth century, discovered the relation of the electric current to the magnetized needle, while Ampere perfected this knowledge. About the same time Davy elucidated the mysteries of the voltaic pile, and Faraday described the induced current.

Electrotherapeutics, however, was not placed upon a scientific basis until later when Duchenne and Remak published the results of their studies, and still later Erb, Althaus, du Bois-Reymond, and finally, Moebius, contributed to the literature of the subject.

Many of the modern books on electrotherapeutics give to the reader a too encouraging view of the value of electricity as a therapeutic measure. While it can be said with truth that, when indicated, electricity is a valuable aid in the diagnosis and treatment of disease, its scope nevertheless is limited. One constantly reads that electricity cures apoplexy, hemiplegia of cerebral origin, lateral sclerosis, and similar incurable diseases. No one conversant with the pathology of these diseases, and at the same time, with the physiologic action of electricity, can expect much if any beneficial results from its application in such conditions.

It will be my endeavor to present the subject of electricity in its relation to therapeutic medicine in a rational manner, avoiding the pitfalls of the over-enthusiastic, and of the skeptic as well.

In the diagnosis and treatment of disease by electricity practically five forms of the electric current are employed, namely:—

1. The galvanic current.
2. The faradic, or induced current.
3. The frictional, or static electricity.
4. The sinusoidal current.
5. The high frequency currents.

## THE GALVANIC CURRENT

The galvanic is the most important current. It is generated when two substances differing in potential are placed in contact with each other. The greater the difference in potential, the greater is the amount of current generated.

The voltaic pile is the simplest type of generator of the galvanic current, and consists of a series of plates composed of zinc and copper, arranged alternately, and separated by discs of cloth which are saturated with a weak solution of acid.

The simplest form of galvanic *cell* consists of a jar containing a zinc plate and a carbon plate, immersed in an acid solution. The current flows from the metal more easily affected by the acid within the cell, to the other plate, and if the plates are connected outside of the cell by means of a wire, the current will continue to flow from the carbon plate around again to the zinc plate.

The force which starts the current and keeps it in motion is termed the *electro-motor force*. The current flows through conductors which consist, within the cell, of the acid and the plates, and, without the cell, of the metal wire connecting the plates. The wire is usually composed of copper, as this offers less resistance than most metals to the passage of the current. The metal plates are called the *elements*, and the fluid is termed the *electrolyte*.

By a circuit we mean that the current flows continuously from the zinc to the carbon plate within the cell, and thence through the copper wire connecting the plates externally, back to the zinc plate again. As the current passes through the conductors it encounters resistance.

It will thus be seen that, in studying the character of a galvanic cell we have to deal with electro-motor force, current, and resistance. These qualities are governed by a law which was discovered by Ohm, and named after him.

Ohm's law states that the current equals the electro-motor force divided by the resistance,  $C = \frac{E}{R}$ .

An *ohm* is a unit of resistance; an *ampere* is a unit of current strength; a *volt* is a unit of electro-motor force; and a *coulomb* is a unit of quantity.  $\text{Ampere} = \frac{\text{Volt}}{\text{Ohm}}$

## ELECTRO-MOTOR FORCE, (E. M. F.)

The electro-motor force starts the electric current and keeps it in motion. It depends upon a difference in potential between two bodies. It may be increased by changing the nature of the plates and liquid, but it has no relation to the size of the cell. It may also be increased by increasing the number of cells, which must be in series; that is, the copper plate of one cell is connected with the zinc plate of the next, and so on, the terminal wires finally being connected with the carbon plate of the first cell, and the zinc plate of the last cell.

Electro-motor force may be compared, for purposes of elucidation, to the pressure which is exerted by water contained in a tank which is connected by a tube with a second tank. If the tanks are on the same level no pressure is exerted by the body of water in one tank on that of the other. But if one tank is lowered, immediately the pressure in the other tank forces the water into the tank at the lower level, in which the pressure is lower. The lower tank may be compared with a substance of low potential, and the other tank with a substance of high potential.

A substance which is of a higher potential than another is spoken of as electro-positive; to the other, the name electro-negative is given.

An electro-motive series consists of a list in which substances of higher potential are placed first, as: Zinc, cadmium, tin, lead, iron, nickel, bismuth, antimony, copper, silver, gold, platinum, and graphite.

## RESISTANCE

Resistance is offered to the electric current just as pipes of different calibre present varying amounts of resistance to a volume of water. The current encounters resistance in the conductors used without the cell, and the elements and fluid within the cell. The former is termed external resistance, the latter, internal resistance. Some metals offer more, or less, resistance than others. Good conductors offer little resistance, while insulators oppose the passage of the current to such an extent that it is practically intercepted.

The good conductors are silver, copper, gold, aluminum, zinc, platinum, iron, tin, lead, German silver, antimony, and mercury.

The partial conductors are carbon, graphite, acids, saline solu-

tions, sea-water, melting ice, water, stone, dry ice, dry wood, porcelain, and dry paper.

The insulators are wood, silk, sealingwax, sulphur, resin, gutta-percha, india-rubber, shellac, paraffin, vulcanite, glass and dry air.

Resistance follows definite laws. It varies directly (1) with the length of the conductor; (2) inversely, with the area of the cross-section; (3) directly, with the character of the conductor, and (4) with the temperature.

The external resistance of a cell is that which is offered by the conductors without the cell, as well as the electrodes and the interposed body when it is used therapeutically.

The internal resistance varies from a fraction of an ohm to 2 ohms, and is influenced by the character of the liquid, the distance the plates are separated from each other, the diameter of the plates, and the nature of the plates.

The human body offers great resistance to the passage of the current. The skin is the poorest conductor, while the brain is the best. Fat, muscle-sheaths, cartilages, and especially bones, offer a great amount of resistance. The resistance of the skin of the plantar surfaces of the palms is greater than the resistance of the skin of the body where the texture is more delicate.

Larrat estimates the comparative resistance offered by various tissues as follows, using 1 as the unit:

<i>Tissue</i>	<i>Ohms</i>
Muscles .....	1
Nerves .....	2.5
Cartilages .....	2.5
Bone .....	15 to 20
Skin and epidermis .....	100 to 500

The specific reactions of some of the tissues are estimated according to Dawson-Turner as follows:

	<i>Ohms</i>
Cerebrospinal fluid .....	29
Urine .....	45
Blood .....	72
Muscle (longitudinally) .....	200
Muscle (transversely) .....	1.3
Nerve (longitudinally) .....	1.2
Nerve (transversely) .....	3.2



By Kohlrausch's method, employing electrodes 5 cubic centimeters in diameter, it is estimated that the resistance equals:

	<i>Ohms</i>
Hand to hand .....	1375
Through one hand .....	900
Cheek to cheek .....	600
Frontal eminence .....	800
Just above one ankle to just above the other ankle.....	700
Through the calf of the leg .....	350

As the individual advances in age the resistance is increased.

The resistance of the current diminishes as it continues to flow through the human parts; this is due to the congestion, the increase in temperature, and the stimulation of the sweat glands it causes. Thus the amount of fluid is increased, and the resistance consequently reduced, as the amount of fluid in the tissues affects directly the degree of resistance.

The resistance is lowered (1) the nearer the electrodes are together; (2) the larger the electrodes; (3) the firmer the electrodes are held to the skin; and (4) when the temperature of the skin is elevated. The resistance is also decreased in Graves's disease, dropsy, febrile states, and copper and mercury poisoning.

#### CURRENT STRENGTH

The amount of current is related, as has already been stated, to the amount of electro-motor force and resistance in obedience to Ohm's law. To increase the current when the external resistance has been lowered to a minimum, it will be necessary to increase the electro-motor force.

In applying galvanism therapeutically to the human body it is impossible to diminish the external resistance very much, although it may be done to a certain extent by a proper choice of electrodes, and by lowering the resistance of the skin, which can be accomplished by increasing its moisture, and by wetting the electrodes thoroughly. In order to increase the current strength it becomes necessary to increase the electro-motor force. This is done by increasing the number of cells, which must be placed in series. The amount of internal resistance is also increased at the same

time, however; but this is so insignificant that it can be entirely disregarded.

For example, if the external resistance amounts to 500 ohms, and the electro-motor force of one cell is 2 volts, and the resistance 5 ohms, according to Ohm's law,  $C = \frac{2}{5+500} = \frac{2}{505}$ , or about  $\frac{1}{250}$  of an ampere. If now 10 cells in series are added, according to Ohm's law  $C = \frac{10 \times 2}{10 \times 5 + 500}$  or  $\frac{20}{550}$ , or about  $\frac{1}{25}$  of an ampere. The increase in internal resistance does not materially affect the amount of current. If the external resistance be so small that it can scarcely be measured, then Ohm's law would give us,  $C = \frac{2}{5}$ , or  $\frac{2}{5}$  of an ampere. If 10 of the cells be joined in series, then  $C$  would equal  $\frac{10 \times 2}{10 \times 5}$  or  $\frac{20}{50}$  or  $\frac{2}{5}$  of an ampere, thus showing no increase in the amperage over that of one cell. This is because the internal resistance is increased with the increase in the number of cells, the external resistance being insignificant. To increase the current in this case it is necessary to arrange the cells in such a manner as to decrease the internal resistance. This may be accomplished by increasing the size of the elements, and by joining the similar elements of 2 or more cells. Cells so arranged are said to be in parallel, and are equivalent to one large cell in which the voltage remains unchanged while the resistance is lowered by the addition of each cell. For example, if we have 5 cells in parallel,  $C = \frac{2}{\frac{5}{5}}$  or  $\frac{2}{1}$  or 2 amperes. If cells are placed in parallel, with a great external resistance (for example, 500 ohms), then  $C = \frac{2}{500 + \frac{5}{5}}$  or  $\frac{2}{501}$  or about  $\frac{1}{250}$  of an ampere.

It will thus be seen that, in applying the galvanic current to the human body, where the external resistance is great, the cells should be in series. If the current is employed in galvano-cautery work, under which conditions the external resistance is slight, the cells should be in parallel.

#### APPARATUS

There are several different types of simple cells which may be utilized to supply the current for medical and other purposes. Of these, the most important in medical work are the Leclanché cell and the Grenet cell.

The Leclanché cell consists of a jar containing a solution of ammonium chloride, into which are placed a rod of zinc and a cylinder composed of carbon, manganese peroxide, gum, and potassium bisulphate. The ammonium chloride yields free ammonia, and also forms zinc chloride. Hydrogen is liberated, which, coming in contact with the manganese, reduces it to a sesquioxide. The manganese peroxide acts as a depolarizer, neutralizing the hydrogen which otherwise would accumulate on the carbon plate, a condition which increases the internal resistance. The counter electro-motor force set up by the hydrogen is termed polarization.

This cell has the advantages that (1) no chemical reaction goes on while the cell is not being used; (2) it requires little attention; (3) it is readily renewed; (4) it lasts a long time; and (5) it is cleanly. The electro-motor force produced is about 1.5 volts, and the internal resistance varies from 1 to 5 ohms.

The Grenet cell (Figs. 1 and 2) is composed of a jar containing a solution of potassium bichromate, mercury oxysulphate, and sulphuric acid, in which is immersed a zinc plate and 2 plates of carbon. The zinc plate is attached to a rod so that it can be raised from, and lowered into, the fluid at will. The electro-motor force of this cell is about 2 volts, and the internal resistance under 1 ohm.

The so-called dry cells are a modification of the Leclanché cell. They are less useful and less permanent. A dry cell consists of a box or vessel of hard rubber which contains a zinc and a carbon plate packed into a paste composed of some electrolyte.

The Daniel cell (Fig. 3), the Grove cell, and the Bunsen cell are less useful in electrotherapeutic work, and need not be minutely described.

The source of galvanism for medical purposes may be either such cells as have just been described, or the current from dynamos.

A galvanic battery is made up of a number of cells arranged in series. In order to utilize and regulate the current properly a battery should be supplied with a controller, a rheostat, a current reverser, a milliamperemeter, electrodes, and covered wires called rheophores, which are employed to connect the battery with the electrodes.

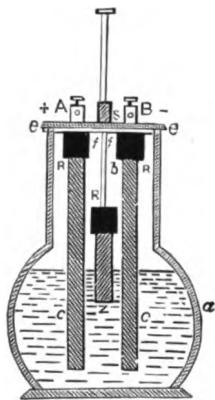


FIG. 1.—Grenet cell.

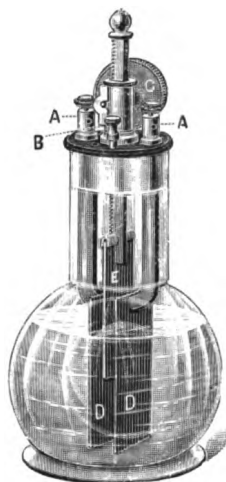


FIG. 2.—Grenet cell.

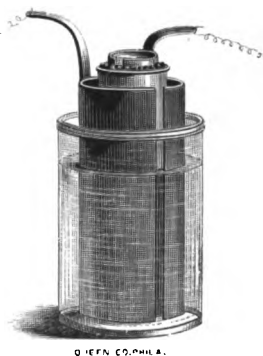


FIG. 3.—Daniel cell.

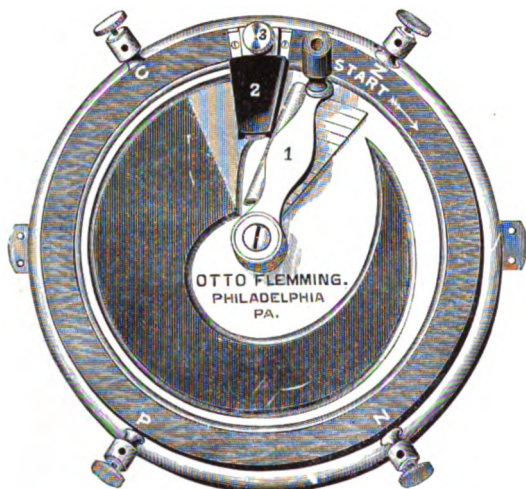


FIG. 4.—The Massey-Flemming current controller.

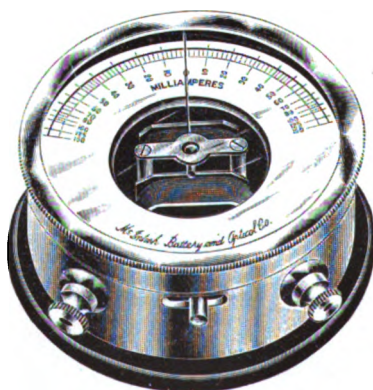


FIG. 5.—The McIntosh milliamperemeter.

Controllers, selectors or collectors, are of three forms: the plug, the sledge or rider, and the dial.

The plug system is not very satisfactory. The form of plugs most commonly used is composed of two rheophores, one connecting the positive pole of the first cell to one terminal post, while a second bifurcated rheophore is used to connect the negative pole with a second terminal post. The cells are in series, and between each pair of cells there is a tube in contact with the wire which connects the cells. To complete the circuit one end of the bifurcated rheophore is placed into one of the tubes. The current is then increased a cell at a time by placing the free end of the bifurcated rheophore into the next tube, and then removing the other end from its position, to be placed in turn into the next tube, if still farther increase of current is desired.

The sledge, or rider, consists of a movable strip which slides along a base made up of conductors attached to cells in series. Terminal posts are attached to this rider, and as it is slid along an increasing number of cells are thrown into the circuit.

Rheostats are employed to regulate all the current strength possessed by the battery, and may consist of water, wire or carbon. The fluid rheostat acts by introducing into the current the resistance offered by a volume of water, acidulated water, or solutions of copper sulphate, or zinc sulphate.

The best form of liquid rheostat consists of two plates of carbon so constructed that by turning a crank the free ends can be separated or approximated. These plates of carbon are attached to both poles of the battery and both rheophores at the same time. When the plates touch under water the current is closed and none passes out the rheophores. As they are separated more and more the resistance offered by the water to the passage of the current from plate to plate is so great that the current escapes through the rheophores, where the resistance is less. This is called the shunt method of controlling the current.

This controller may also be used to interpose a volume of water into the current, the amount of which depends upon the resistance offered by the water.

Wire rheostats are very reliable, and may be constructed in

such a way as to reduce the electro-motor force without affecting the current strength.

Graphite rheostats (Fig. 4) are very satisfactory to control both the current from the cells or the dynamo.

The dial or crank selector is composed of a number of buttons or studs in a circle. Each button is connected with the negative pole of a cell, all the cells being in series. A movable bar fastened to the pivot in the center by a pin which is attached to the negative rheophore can be moved from stud to stud in such a way that the bar touches the next stud before it leaves the one with which it is already in contact.

The rheostat described by Rudisch and Jacoby in 1884 is a modification of the same principle, and gives satisfactory results.

#### MEASUREMENT OF THE CURRENT

For practical purposes it is essential to measure the current. The voltage, on the whole, may be left out of consideration, though it must be remembered that if the voltage is low the distress and pain given to the patient are reduced to a minimum.

The principle of the galvanometer depends upon the fact that a magnetic needle, suspended beneath a wire through which a current is passing, is deflected from its normal position. If the current flows in a wire above the needle from south to north, the north end of the needle is deflected to the west; but if the current runs from north to south, the north end of the needle is deflected to the east. The reverse is true if the current is below the needle.

If then a magnetic needle is surrounded by a wire the current runs in one direction above, and another below the needle, and the needle is deflected in the same direction by both currents.

The deflection of the needle is influenced also by the strength of current, and the number of coils of wire. It is necessary, in applying this principle to the manufacture of the galvanometer, to overcome the influence offered by the magnetism of the earth, which may be accomplished by placing the needle magnetically north and south.

In electrotherapeutics the milliamperemeter (Fig. 5) is used instead of the galvanometer. The former is so constructed that the needle will indicate 1/1000 part of an ampere.

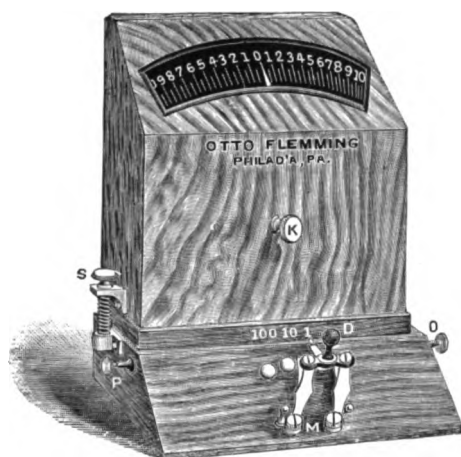


FIG. 6.—The Fleming milliammeter.



FIG. 7.—Nickel-plated foot plate.





FIG. 8.—Nickel-plated foot plate.



FIG. 9.—Rectal electrode.



FIG. 10.—Rectal electrode with hard rubber.

The Flemming instrument (Fig. 6) is a convenient and excellent one, and can be employed to measure  $\frac{1}{2}$  a milliampere. If more than 10 milliamperes are required a definite number of coils is thrown into the circuit by means of a switch, and the reading is multiplied by 10 or 100, as the case may be.

*Current Reversers.* Current reversers are essential parts of a galvanic battery, and without them it is impossible to make careful and accurate observations.

*Rheophores.* Rheophores, or conducting wires used for the purpose of connecting the battery with the electrodes, are constructed of fine strands of copper wire, insulated usually by cotton, silk, or rubber. The ends are metallic, so that they can be readily attached to the binding posts of the battery. They should be four or five feet long and flexible.

*Electrodes.* Electrodes (Figs. 7 to 17) are employed to apply the current to the body, and may be of various shapes and sizes. The handles of the small electrodes are of wood or hard rubber so that the operator may apply the electrode without receiving the current himself. Larger electrodes may be made of some pliable metal to which is attached a sponge. Such an electrode can the more readily conform to the shape of the body to which it is designed to apply the current.

#### BATTERIES

Batteries for the development of the galvanic current may be either portable or stationary; or, the galvanic current may be obtained by means of a transformer or controller from the street current.

The best portable battery consists of a box containing 24 to 36 small cells which are arranged in a series. The one manufactured by Otto Flemming of Philadelphia (Fig. 18) has proved very satisfactory. The zincs and carbons are fixed in position on a stationary platform, while the vessels containing the acid solution rest upon a movable shelf. The shelf on which the vessels rest is lifted up until the plates are immersed in the liquid, when the current at once begins to be generated. After using the battery the shelf supporting the small jars is lowered again. The strength of the current is regulated by increasing or decreasing the number

of cells in the circuit, and this is done preferably by means of the plug selector above described.

The dry-cell galvanic battery is not very practicable, because such a large number of cells is necessary to produce a proper current that the battery is cumbersome. Moreover, the current from dry cells is easily exhausted.

The cell of the portable galvanic battery made by Waite and Bartlett Mfg. Co., New York (Fig. 19), gives 1.9 volts. The current is regulated by means of a bifurcated rheophore. The principle of the construction of this battery is the same as that of Flemming.

The batteries containing less than twenty or thirty cells are of very little practical value.

In the portable galvanic battery of the J. Kidder Mfg. Co., N. Y., the sledge-controller is employed (Fig. 20).

The ideal apparatus for applying the galvanic current is one which utilizes the street current. It is very necessary that this current should be properly controlled, and to this end many apparatuses or controllers have been devised.

One kind of controller used to reduce the street current consists of a series of wires placed in shunt with the patient, which permits the operator gradually to increase the voltage or amperage.

A second type of controller utilizes one or more lamps which are placed in the circuit for the purpose of reducing the voltage. The current is then regulated by either a Massey controller, a Geiger controller, or a Vetter volt-selector controller. The latter two are dial controllers, the principles of which have already been described.

An apparatus recently manufactured by Otto Flemming has given much satisfaction. It consists of a table on which a graphite controller rests, through which the current is allowed to pass before it reaches the terminal posts. Upon this table also are a milliamperemeter and a pole-reverser interposed in the current.

The cabinet apparatus manufactured by the Kidder Company is composed of shelves to support twenty cells, a faradic apparatus supplied with a rapid interrupter, a dial controller, and a pole-reverser (Fig. 21).

An apparatus for adapting the street current is made by the



FIG. 11.—Interrupting electrode.



FIG. 12.—Hair brush electrode.

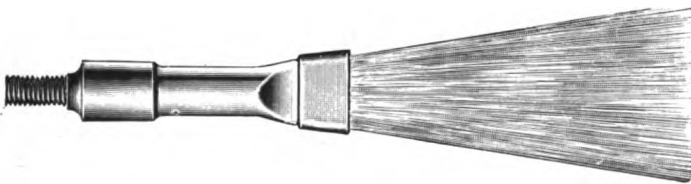


FIG. 13.—Metallic brush.

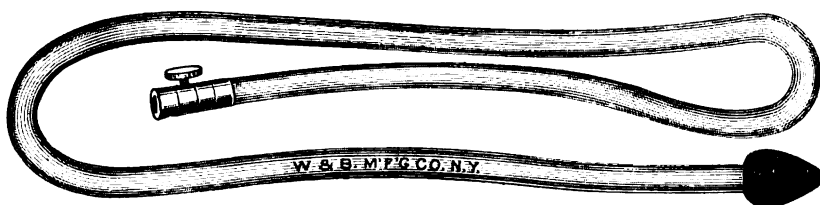


FIG. 14.—Stomach electrode.

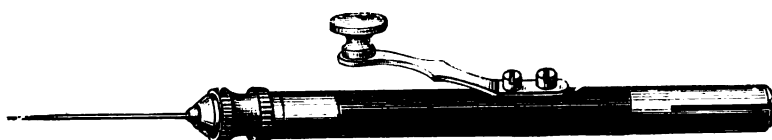


FIG. 15.—Needle holder.

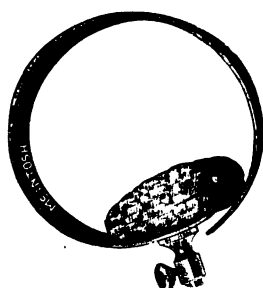


FIG. 16.—Electrode with spring attachment.

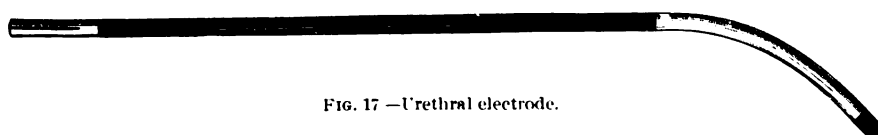


FIG. 17 —Urethral electrode.

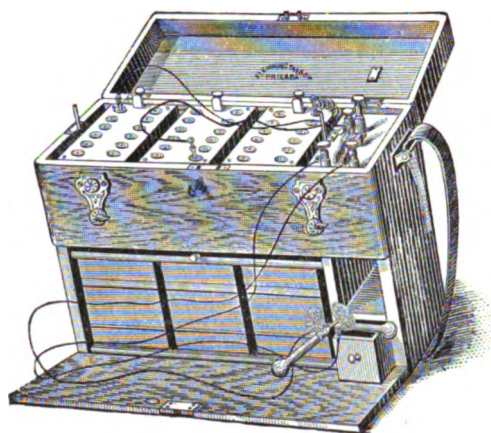


FIG. 18.—Portable galvanic battery.

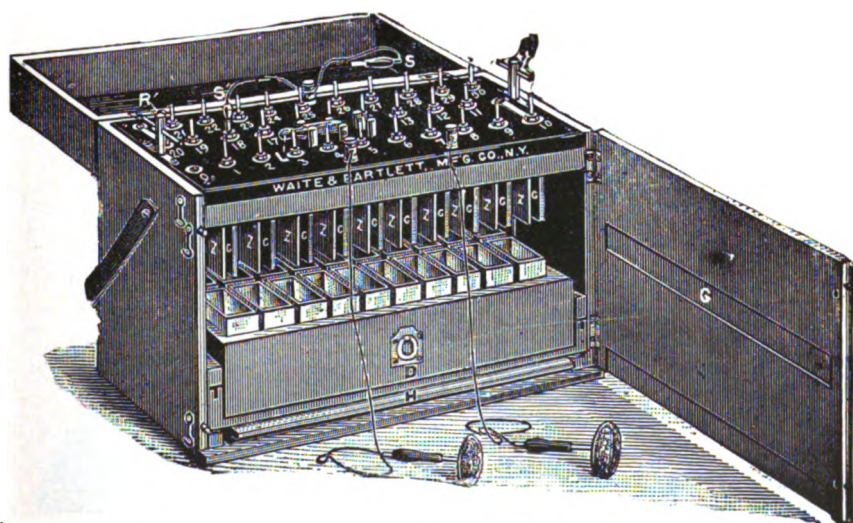


FIG. 19.—Portable galvanic battery.



FIG. 20.—Kidder portable galvanic battery.

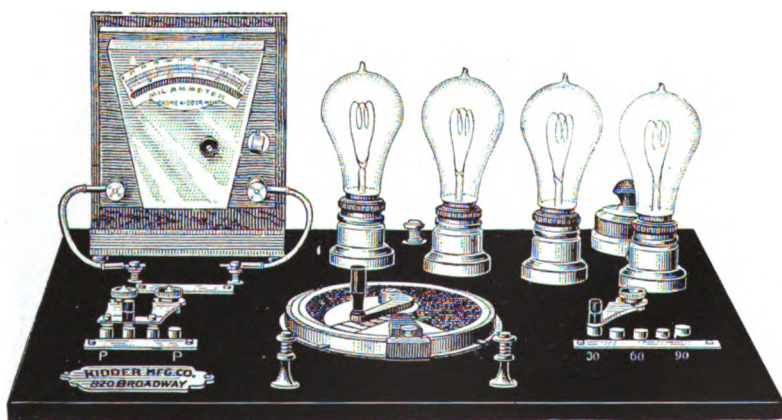


FIG. 21.—Table for employing street current.





FIG. 22.—Galvanic, faradic, and lamp illumination wall cabinet.





Waite & Bartlett Mfg. Co., of New York, and contains a milliamperemeter, a rheostat, and a pole-reverser. This switchboard is also made with an Englemann high coil attachment (Fig. 22).

#### EFFECTS OF ELECTRICITY

The chemical effect of electricity which needs to be considered is its electrolytic action.

*Electrolytic Action.* When a current passes through certain substances they are decomposed. That portion which is given off at the negative pole is called kations, and that decomposed at the positive pole, anions. This is called electrolysis, and the substance decomposed, an electrolyte.

*Cathaphoric Action of the Electric Current.* When two fluids of different density are separated by a porous substance, and two electrodes from a cell are placed respectively in the two fluids, the fluids will pass from the anode to the cathode. This is termed cathaphorisis.

*Physiologic Effects.* A knowledge of the physiologic effects of electricity is most essential to the electrotherapeutist. The effect of the current upon the muscles, the motor nerves, the sensory nerves, including the spinal nerves, the vasomotor and secretory nerves, and finally, the effect upon the brain, spinal cord, and the sympathetic nervous system, must be considered.

The action of electricity upon the motor nerves and muscles is of great importance. As it is practically impossible to stimulate a muscle electrically without stimulating at the same time its nerve supply, for all practical purposes the effect of electricity upon the muscle and the nerve is the same.

Electricity has a qualitative and a quantitative action upon the muscles and nerves.

Before the qualitative action of electricity upon the muscle and nerve can be clearly understood certain facts must be considered. Of these the first is electrotonus.

*Electrotonus.* When a current is applied to a nerve it is found that there is a condition of increased excitability at the negative pole, and one of diminished excitability at the positive pole. This change in the condition of the excitability of the nerve

pole is termed katelectrotonus; the diminished excitability at the positive pole, anelectrotonus.

*Pflüger's Law.* If a muscle is stimulated by the galvanic current there occurs a contraction when the current is closed, if the cathode is placed over the muscle and the anode in an indifferent position.

If the current is increased a contraction will follow the closure of the current with the anode over the muscle.

If a still greater current is now employed there will be a muscular contraction when the current is broken with the anode over the muscle, and finally, when current is broken with the cathode over the muscle. No contraction occurs in a muscle when the current is at rest. This constitutes Pflüger's law.

*Normal Muscular Reaction.* The contraction which follows the application of a weak galvanic current with the cathode over the muscle and the anode between the shoulders at the closing of the current, is called the cathodal closure contraction (CaClC). This is the first response in the normal muscle which it is possible to observe.

If the current is now reversed, the position of the anode now being over the muscle, and the current closed, there will be no contraction with the same amount of current. A greater amount of current will now be necessary to cause a contraction of the muscle, which is called the anodal closure contraction (AnClC).

A still greater increase in the current is required to produce an anodal opening contraction (AnOC), and a cathodal opening contraction (CaOC). The normal muscular reaction may be stated as follows:  $\text{CaClC} > \text{AnClC}$ ,  $\text{AnOC} > \text{CaOC}$ .

Any variation from these phenomena is termed a qualitative change in the muscular reaction, and may be found in certain diseases of the muscles to which reference will be made later.

To obtain these reactions a large, or indifferent, electrode is placed at some region as far remote as possible from the nerve or muscle to be studied, while the electrode applied over the muscle or nerve should be small. This is termed the polar method. Both electrodes should be covered with absorbent cotton, thoroughly saturated with water, and firmly applied to the skin. The small electrode should be supplied with a device upon the handle by

which the current can be readily made or broken by the pressure of the finger. This is termed an interrupting electrode (Fig. 11).

A milliamperemeter should be interposed in the circuit in such a way that it can be thrown in and out of the circuit by the turning of a switch. The current is then turned on, and gradually increased, while at the same time, interruptions are being slowly made until the muscle begins to contract. The current is then closed, the milliamperemeter introduced into the circuit, and the amount of current measured. This gives the amount of current necessary to bring about a cathodal closure contraction.

In order to study the AnCIC the current is reversed, preferably by means of a current reverser attached to the battery, and the smallest amount of current is employed that will produce a contraction upon closing the circuit. This is afterward measured in the manner just described.

When the quantitative excitability of a nerve is to be tested the small, or localizing, electrode is placed over the nerve to be studied. The average excitability of nerves was studied by Stintzing, with the following results:

<i>Nerve.</i>	<i>Milliamperes</i>
Musculo-Cutaneous .....	0.17
Accessor .....	0.27
Ulnar .....	0.55
Median .....	0.9
Crural .....	1.05
Peroneal .....	1.1
Frontal .....	1.45
Tibial .....	1.45
Facial .....	1.75
Radial .....	1.80

*Quantitative Reaction.* The muscular contraction which follows stimulation by electricity varies with the amount of current used.

The contraction which follows stimulation by a minimum amount of current represents the quantitative reaction of that muscle. This varies in different subjects, and in different muscles and nerves.

In studying the quantitative reaction of a given nerve or muscle comparisons should be made with the corresponding nerve or muscle on the opposite side, or in a healthy subject.

The sensory nerves respond first to the CaCl. When more current is added the AnCl causes a burning sensation, and so on with the AnO and CaO.

G. W. Jacoby has described a physiologic electric reflex. A contraction of the levator menti and quadratus menti muscles follows the application of a CaCl current to the anterior radial surface of the forearm just above the wrist, with the indifferent electrode over the sternum. He claims that this appears in 70 per cent. of healthy individuals.

The nerves of special sense exhibit a specific reaction to galvanic stimulation. When the galvanic current is applied in the neighborhood of the tongue, a taste perception is produced, consisting of an acid metallic taste when the anode is applied to the cervical region; or an alkaline and bitter taste when the cathode is placed in the same region.

When the optic nerve is brought under the influence of the galvanic current a sensation of light is produced. If the CaCl current is applied over the closed eye, according to Bremer, a disc colored in the center and surrounded by a lighter field is perceived. The CaO current causes a reverse in light sensation, that is, the color of the disc and field are exchanged. The CaCl and the AnO impressions correspond, and the AnCl and CaO correspond.

When the auditory nerve is stimulated by the galvanic current a sense of sound is perceived, but only with the CaCl and the AnO. The CaO and the AnCl do not cause any sounds.

The olfactory nerve is also susceptible to stimulation.

The vasomotor nerves, when stimulated, appear to cause faint contraction of the blood vessels, and afterward dilatation.

The salivary secretion and sweating may be caused by stimulation of the secretory glands, and it is generally supposed that the secretion of the glands of the stomach is increased by the application of the galvanic current percutaneously.

When the galvanic current is applied to the temporal regions, or to the nape of the neck and forehead, dizziness, actual vertigo, vomiting, and even syncope are experienced if the current is sufficiently strong. If the current is closed the individual tends

to sway to the positive side. The reverse of this, however, is not always uniformly present.

According to Erb,  $\text{AnCl}$  stimulates the cortex more than  $\text{CaCl}$ . It has, however, been impossible by this method to stimulate any portion of the brain sufficiently to cause any more definite results than those just described. Stimulation of the motor cortex percutaneously has never produced muscular contractions.

Experiments have been made with a view to studying the effect of electricity upon the spinal cord, but the conclusions of these experiments show us that so far no definite phenomena follow indirect stimulation of this portion of the nervous system.

The action of the galvanic current upon the internal organs is insignificant, with the exception of perhaps the bladder, rectum, and the stomach. The muscular fibers of the stomach appear to be affected more by the faradic than by the galvanic current.

#### THE FARADIC CURRENT

The faradic, or induced current, was discovered by Faraday in 1831. He found that a current was momentarily induced in a closed circuit when a magnet was brought near or withdrawn from the circuit. Later it was discovered that the wire through which a current was passing had the same effect as the magnet. The faradic battery is based upon this principle.

The faradic battery consists of two coils of wire so arranged that one may surround the other without the coils in any way coming into contact with each other. Such an induction coil is called a Ruhmkorff's coil. The inner coil is called the primary coil, and the outer, the secondary coil.

The inner coil is connected with a galvanic cell and a device is introduced into the circuit by which the current is interrupted. At each make and break of the current in the primary circuit there is induced in the secondary circuit a momentary current. The intensity of the induced current depends upon the extent by which the primary is covered by the secondary coil. It may also be increased by the presence of a soft iron bar which is inserted in the primary coil. While the primary current is passing, this bar becomes a magnet, and thus re-enforces the induced current caused by the primary current.

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The interrupting device consists of a piece of soft iron surrounded by a coil of wire, a movable bar or needle superimposed above the upper end of the soft iron bar, and above the movable bar or needle, an armature upon which the movable bar, or needle, impinges in its natural position. One end of the primary coil is connected with the coil surrounding the soft iron bar, and the other end of this latter coil is connected with the armature above. The movable bar, or needle, is connected with a wire which leads to one element of the galvanic cell, and the other element of the galvanic cell is connected with the free end of the primary coil. It will thus be seen that when the movable bar is in contact with the armature above, the current is closed. At once the soft iron bar becomes a magnet and attracts the movable bar, or needle, toward it. At the moment when it is drawn away from the arm the current is broken, the soft iron bar ceases to be a magnet, and the movable bar comes again in contact with the armature, and so on. Each time the current is closed and each time it is broken by this device there is generated within the secondary coil an induced or secondary current. The secondary coil is connected with terminal posts to which the rheophores are connected (Fig. 23).

The strength of the current in the battery is increased or diminished by exposing more or less of the secondary coil to the influence of the primary coil. To effect this end the secondary coil must be adjusted upon a movable stage, so that a definite amount of the primary coil may at will be covered by the secondary coil.

The current in the secondary coil, which is created when the primary coil is closed, is in the opposite direction from the primary current, but in the same direction when the primary current is opened. When the current in the primary coil is allowed to flow continuously no current is induced in the secondary coil. The current induced by the opening of the primary current is stronger than the closing current.

Faradic batteries may be either portable or stationary (Figs. 24 to 27).

The faradic current differs from the galvanic current not only in its physical effect, but also in its physiologic effect. The cur-

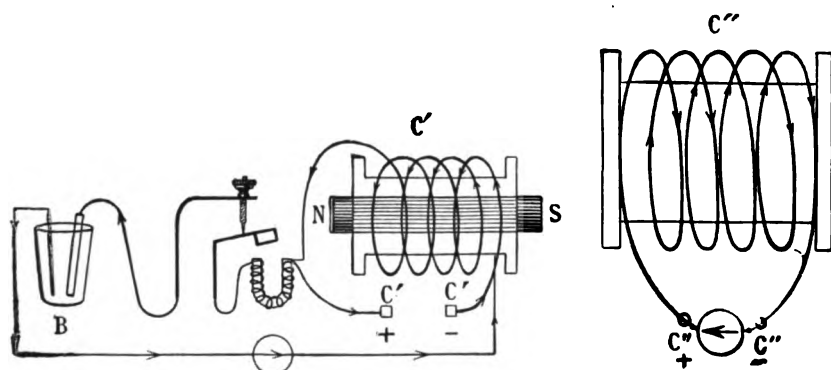


FIG. 23.—Showing a primary coil, with an automatic interrupter, in connection with a galvanic cell; and secondary coil.



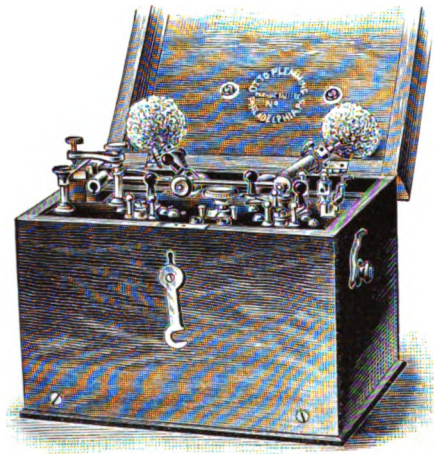


FIG. 24.—Faradic dry cell battery.



FIG. 25.—Portable faradic battery.

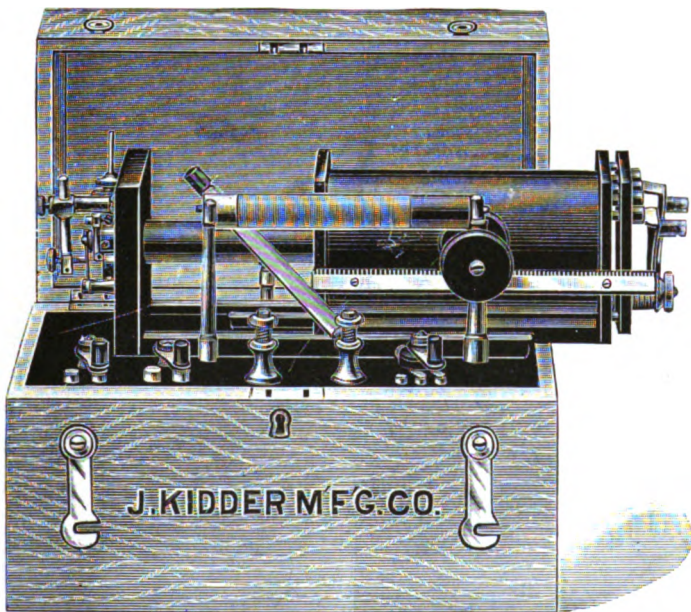


FIG. 26.—Portable faradic battery.

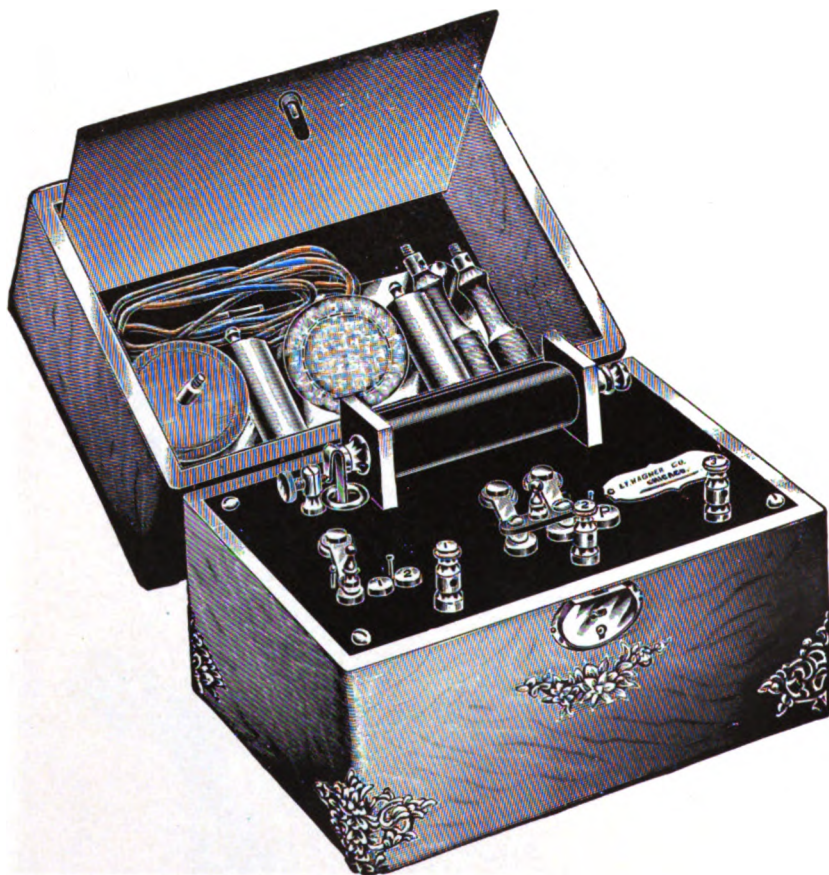


FIG. 27.—Portable faradic battery.

rent is an interrupted and re-enforced one. While the electro-motor force is very high, current strength is very low. It does not produce electrolysis with water, and cannot be measured by an ordinary galvanometer.

The physiologic action of the faradic current probably depends largely upon its power to produce muscular contractions, as well as its stimulating influence upon the peripheral nerves. The chemical action is probably only momentary, because the polarity of the current is constantly changing, and one current counteracts the effect of the other.

It is probable that the chief influence that the faradic current has upon the human body, as has already been stated, depends upon the amount of muscular contraction which is caused. In this way the muscles are exercised, the circulation is stimulated, and nutrition indirectly influenced.

The faradic current may be employed for diagnostic and therapeutic reasons. It is chiefly of importance in deciding whether a muscle has undergone any degeneration or not. If the muscle responds less actively than normal to the faradic current it is spoken of as a quantitative diminution to the faradic current, and indicates some degeneration of the muscle. When the muscles fail to respond altogether to the faradic current it is a sign that there is a profound degeneration of the muscle, probably so intense as to show the reactions of degeneration. It has been claimed by some that thus we can differentiate between the ovarian pains of hysteric and inflammatory origin.

The faradic current may be applied either in the form of general faradism or local faradism, and the current may be rapidly or slowly interrupted. By general faradism I mean the application of the faradic current to the motor points all over the body, and it is preferable to employ the slowly interrupted current. The application should occupy about an hour's time, including the application of the rapidly interrupted current, with the electrodes placed one at the nape of the neck, and the other at the soles of the feet. The current should be allowed to pass through the body for 15 minutes.

The faradic brush is a very useful means of producing counter-irritation, and is useful in cases in which the sensation is altered,

as in hysteria, neurasthenia, neuritis, hemiplegia, myelitis and similar affections. In applying the faradic brush it is necessary for the skin to be perfectly dry, to effect which end it is often advisable to use a dry dusting powder. One electrode is placed in an indifferent spot, such as the back of the neck or over the sacrum, and the dry brush is stroked or patted over the affected areas.

#### STATIC OR FRICTIONAL ELECTRICITY

Static or frictional electricity is produced by means of friction, or by induction.

The principles underlying the static machine are founded upon the facts that (a) substances are capable of being electrified by friction, (b) and by induction; (c) electrified substances attract non-electrified substances, and possess the power of communicating electricity to them; (d) substances possessing the same form of electricity repel each other, and substances of unlike electricity attract each other.

The simplest form of static battery consists of a plate which is revolved by means of a crank supported upon two insulated uprights. The friction upon the revolving glass plate is produced by means of a substance composed of leather and amalgam. The current is collected by an armature on the end of which are two combs placed on either side of the revolving plate, and the whole supported upon an insulated upright. As the plate is revolved it and the amalgamated cushion become electrified. The amalgamated cushion is connected with the ground by means of a chain, so that it cannot be raised to a higher potential than the earth. The potential of the glass plate, however, as it is not connected with the earth, can be raised; in other words, it becomes charged with positive electricity. As glass conducts the electricity poorly the charge is confined to a certain area of the glass plate, and remains so until it reaches the combs situated opposite to the rubber. These combs collect the positive electricity and give off negative electricity, charging a certain area of the glass plate at once with negative electricity. The current accumulates in the armature, while a certain amount is given off in the air. The accumulation goes on until the amount given off in the air equals the amount furnished by the glass plate. In order to prevent loss

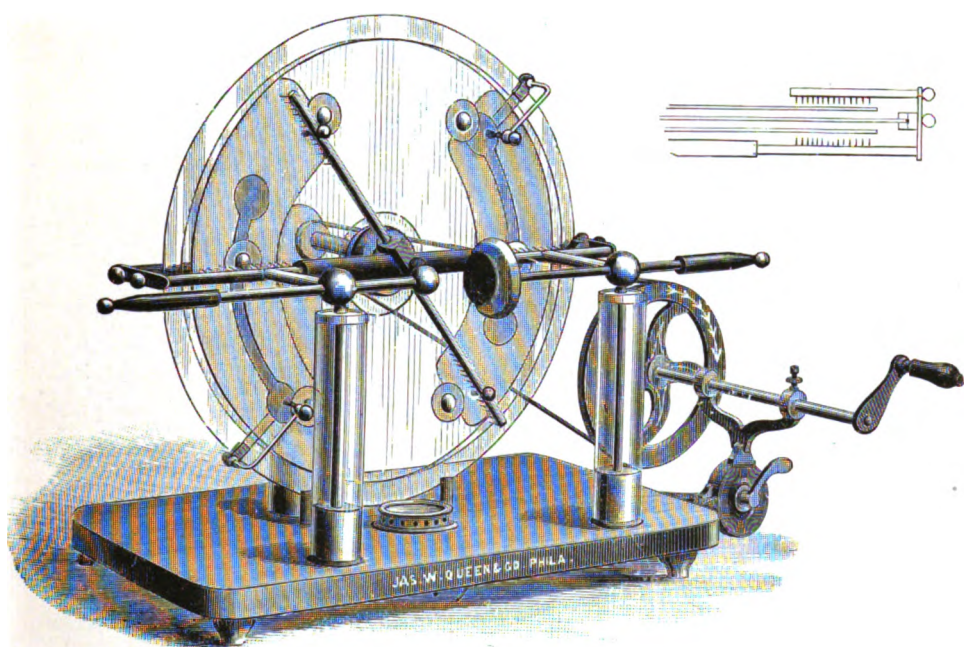


FIG. 28.—Holtz static machine.



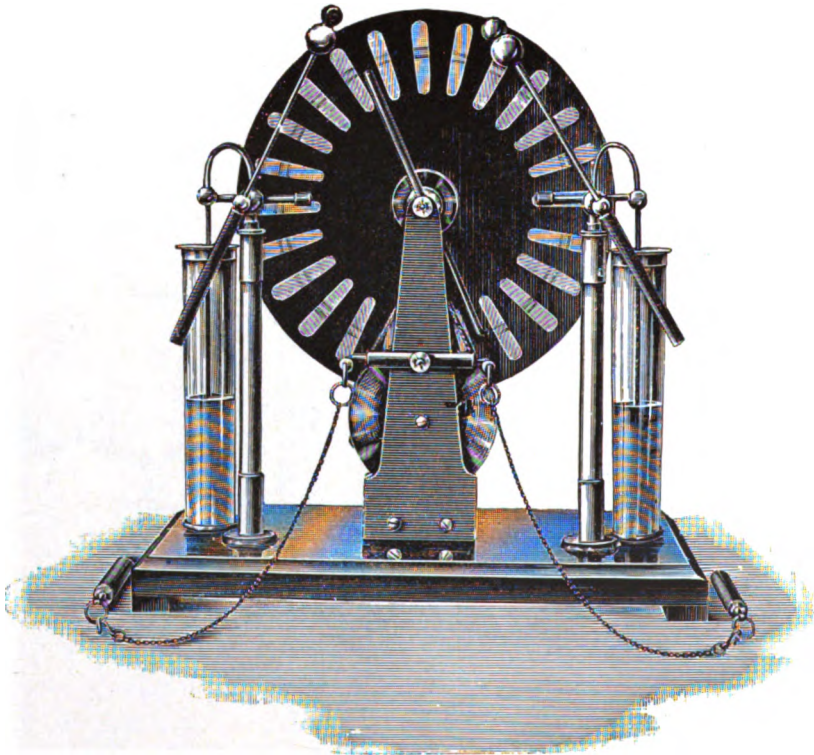


FIG. 29.—Wimshurst static machine.

of electricity by the medium of the air the plate should be enclosed in a glass case, and the enclosed air kept as dry as possible.

The influence machine is a static battery, the principle of which is the same as the electrophorus. An electrophorus consists of a cake of resin contained in a metallic plate, and a disc of metal attached in the center to a handle of wood or glass. The resin cake is rubbed with a piece of fur, when it becomes charged with negative electricity. The metal disc is then placed upon the resin cake, and the disc is grounded by touching it with the finger. Upon withdrawing the metal disc it will be found that it is charged with positive electricity. This is an illustration of the principle that when an electrified substance is brought into the vicinity of other substances it generates a current in them. This phenomenon is called induction.

The Holtz machine (Fig. 28), invented in 1865, was one of the first to utilize the principle of the electrophorus. It consists of two varnished glass plates separated about three millimetres from each other. The plates are of unequal size, and the smaller one is attached to a revolving axle. The larger plate has two openings at opposite ends of a horizontal diameter. Attached to the edges of these openings are two armatures made of shellaced cardboard, placed so that the free end is in the direction in which the plate revolves. Opposite the windows and in front of the revolving plate are two combs, the purpose of which is to collect the current, and these are attached to a rod on the end of which is a brass knob. To the free ends of the armatures are attached two movable metal rods the ends of which can be approximated and separated. The ends of these rods are brought close together, and the glass plate is revolved by means of a crank, one of the armatures having been previously electrified by means of a substance which has been previously electrified by friction.

The Wimshurst machine (Fig. 29) is a reliable and satisfactory induction apparatus. It consists of two circular glass plates which revolve in opposite directions. Attached to the outer surface of the glass discs, which are varnished, are sections of tinfoil and metallic buttons attached at regular intervals. The electricity is collected by means of wire brushes which are attached to rods in



such a way that, as the plates revolve, the metallic buttons come in contact with the wire brushes. There are also two Leyden jars placed on either side of the revolving plates, to the top of which are attached two rods. On the end of each of these rods is a comb which is in close proximity to the revolving plates.

The initial charge in this battery is probably from the atmospheric electricity. These machines are very trustworthy, as they are very apt to work in all sorts of weather.

The Topley machine is a modification of the Holtz.

In the Wagner machine mica is employed for the revolving plates. Two or more plates are placed on each side of two glass plates which are stationary. The mica plates have attached to their outer surfaces metallic buttons which, as the plate revolves, come into contact with a wire brush attached, together with a comb, to an armature for collecting and conducting the electricity. There are six such armatures for each plate. This is a very reliable style of machine, and acts in all sorts of weather. It is necessary, however, to keep the plates free from moisture as much as possible, and for this purpose the whole mechanical part of the machine is enclosed in a glass case.

The Leyden jar (Fig. 30) consists of a jar lined and coated up to about the middle with tinfoil. The jar is corked and through the cork there passes a metallic rod on the end of which is a small chain which touches the inner lining of the jar. If this rod is attached to one of the conductors of a static machine, and the outer coating of tinfoil is attached to the earth, a charge of electricity will accumulate in the jar. This charge may be discharged explosively by bringing the inside coating of the jar in contact with the outside coating, and this may be done by connecting the metallic rod with the outer coating by means of a conductor. The Leyden jar is used to increase the strength of the static machines, the inner coating being attached to the terminal rods.

The static battery frequently fails to develop electricity; that is to say, the initial charge on the revolving plates may be lost, either because the plates have been turned in the wrong direction, or on account of the air in the battery becoming moist. Any loosening of the combs so that they touch the glass, or loosening of the axle by which the plates do not revolve properly, may bring



FIG. 30.—Leyden jars.

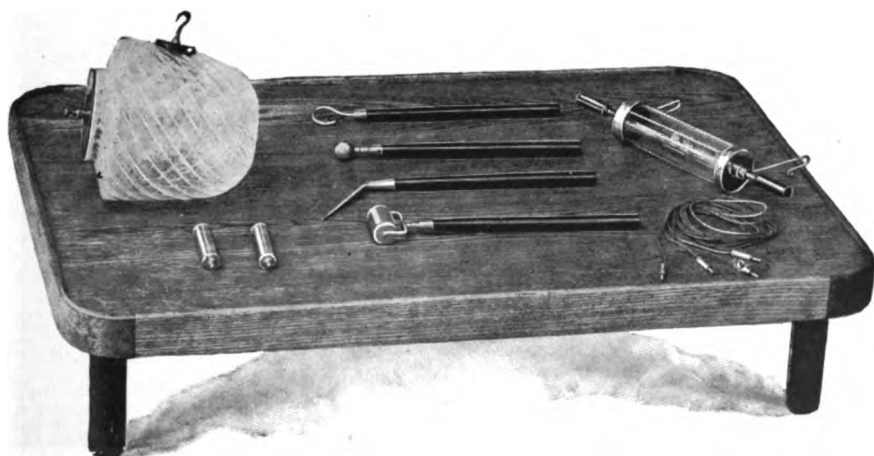


FIG. 31.—Therapeutic attachments for the static machine.



FIG. 32.—Single-point electrode.

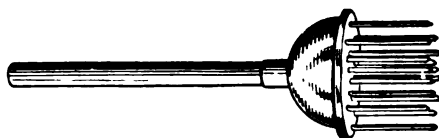


FIG. 33.—Multiple-point electrode.

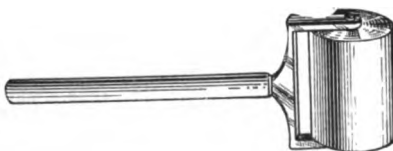


FIG. 34.—Roller electrode.



FIG. 35.—Ball electrode.

about the same condition. The revolving plates may be recharged by means of a Wimshurst machine, or by producing friction on the revolving plates by means of cats' fur. The moisture in the air may be absorbed by means of calcium chloride contained in vessels placed in the cabinet.

The necessary attachments of the static machine consist of an insulated platform for the purpose of supporting the patient; a set of electrodes; two Leyden jars; a chain or covered wire rheophore for the purpose of connecting the electrodes with the brass conductors; and a small motor to revolve the plates (Fig. 31).

The electrodes required to apply the static current consist of the small and large pole electrode; a pointed electrode for the purpose of giving the breeze; sponge electrodes, used for applying the static induced current; and the roller electrode for giving the small sparks (Figs. 32 to 37).

Every static battery should be supplied with a metallic stand upon an insulated base supporting the pole, to which is attached by a movable arm a metal pole terminating at one end in a small point for the purpose of giving the static breeze (Fig. 38).

The static battery may be applied in six different ways: By the direct current; by the indirect current; by the Leyden jar spark; by the static breeze; by static insulation; and by the static induced current.

*The Direct Spark.* To apply this the patient sits or stands upon an insulated platform, and holds in one hand an electrode connected directly with one pole of the machine. The operator holds in his hand a ball electrode which is attached to the other pole of the battery, assisted by a ring-electrode for the purpose of directing the rheophore so that it will not come into contact with the patient. Sparks are then applied to various regions of the body, the size of the spark depending upon the distance the poles are separated from each other, and the speed at which the plates revolve. It is advisable to apply only very small sparks as the pain induced is usually great except in selected cases.

The best results are obtained by gently tapping the body here and there with the ball-electrode while the poles are separated from each other about a quarter of an inch. It may be necessary to separate these poles a little further when the patient has much

clothing on, as sometimes the clothing is thicker than a quarter of an inch, and the spark, instead of jumping from the patient to the electrode, and vice versa, discharges itself at the poles.

*The Indirect Spark.* In giving the indirect spark the patient is placed upon the insulated platform, and is connected with one pole of the machine by means of a rheophore. A chain or covered rheophore is now attached to a gas or water pipe, and with the other pole of the battery sparks are drawn from the patient by means of a ball electrode connected with a gas pipe. This is called the indirect spark, as the electricity takes an indirect course through the earth to form the circuit (Fig. 39).

*Static Insulation.* When this is applied the patient sits as before upon the platform, and is attached to one pole of the battery, while the second pole is grounded by being connected with a gas or water pipe. The poles of the static battery are then separated widely, when it will be observed that the hair of the patient rises up, and that the body gives off a purple light.

*Leyden Jar Sparks.* These are obtained first by attaching the Leyden jars to the poles of the battery, and then connecting the outside coverings by means of a brass rod, when the poles are approximated closely, and the patient attached to one pole of the static machine, and the current applied as in the direct spark. Caution must be employed in giving this current, as the shock is very severe, and therefore the spark should be very small. When the static spark is applied by means of the roller electrode the current is more readily borne, as the sparks are necessarily very small. This is sometimes called frictional spark, or static massage.

*The Static Breeze.* This is applied by means of the pointed electrode (Fig. 40). The patient sits upon the insulated platform and is attached to one pole of the machine, while the opposite pole is attached to the electrode. The poles are widely separated and the pointed electrode is held about 6 or 8 inches from the body, when a sensation as of a breeze will be experienced by the patient. This may be given directly or indirectly. It is direct when both electrodes are attached to the machine, and it is indirect when the patient is connected with one pole of the battery, and the electrode connected with the earth by means of the rheophore which is attached to a gas or water pipe.



FIG. 36.—Universal hard-rubber handle for holding electrodes.



FIG. 37.—Insulated hook for holding conducting cord.

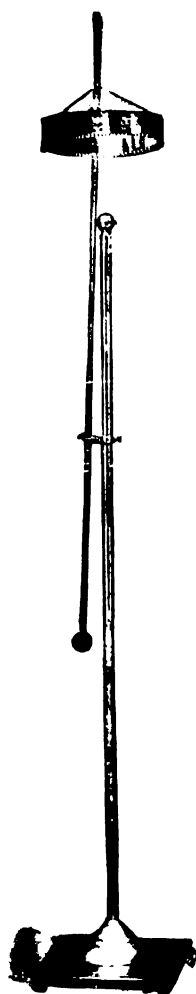


FIG. 38.—Stand for applying the static breeze to the head.

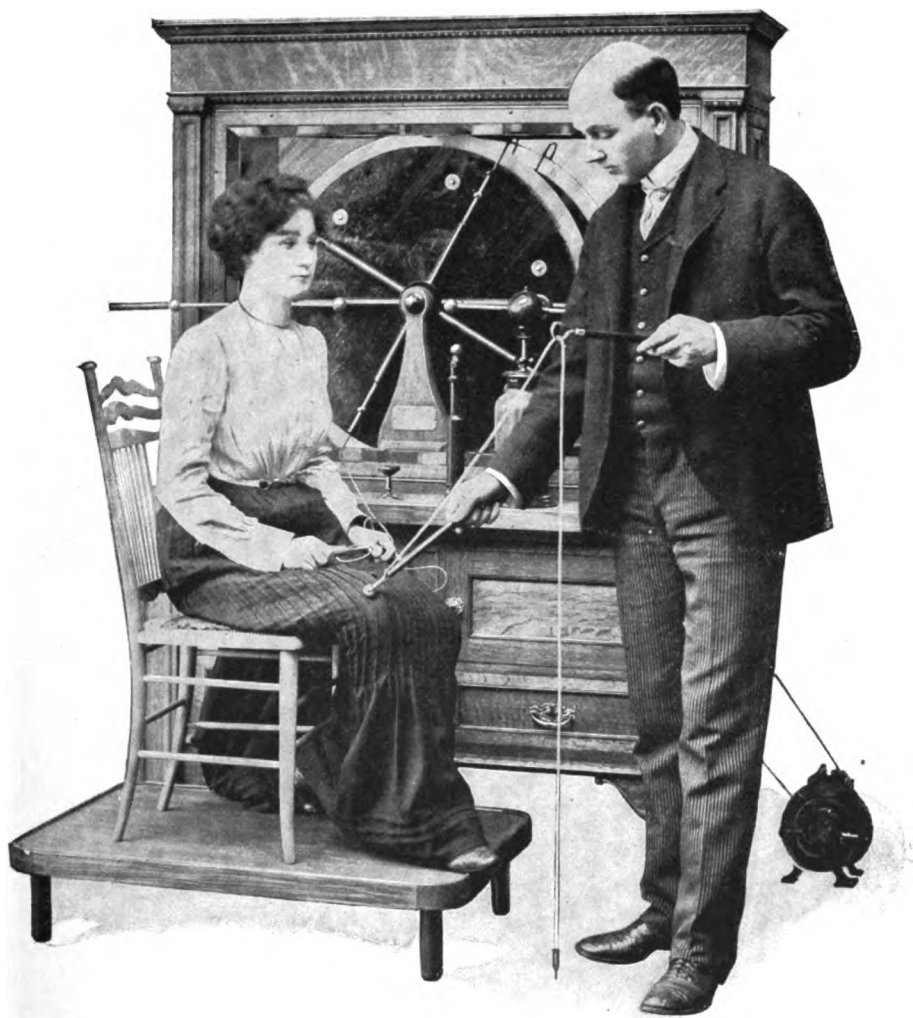


FIG. 39.—Indirect static sparks.





FIG. 40.—Static spray or breeze.



FIG. 41.—Morton's pistol electrode, for applying induced static current.



The static breeze is also applied by means of the metallic stand, already described, and also by a crown of metal, the lower part of which is dentate. This crown is applied within a few inches of the head of the patient, and attached to one pole of the machine, while the patient holds in his hand an electrode attached to the other pole.

The static induced current is derived from the outer coating of the Leyden jars. One jar is connected with the patient by means of a rheophore, and the other jar is connected with an electrode which is used to administer the current to the points desired. The inner coats of the Leyden jars are connected with the armatures of a static battery which are approximated so that the spark is very small and of high frequency. At each time the spark flies across there is induced on the outside of the Leyden jars a current which is used in the manner described. This current, it is claimed by Morton, has an analgesic effect, and it is possible to obtain greater motor effects than with the faradic current. I have myself used this current quite frequently, but have discarded it as not possessing the analgesic properties claimed for it, and also because it is less convenient in its application than other forms of electricity that give the same results.

In applying the static induced current it is preferable to employ Morton's pistol electrode (Fig. 41).

As has been stated, the static induced current is taken from the outside of the Leyden jars, and developed each time the spark flies between the two poles which are connected with the inside of the Leyden jars. Morton's pistol electrode is so arranged that the spark is permitted to jump between two brass balls on the handle of the electrode which can be separated or approximated at will by the finger of the operator.

*The Effects of the Static Current.* The effect of the static current is very similar to that of the faradic current. It stimulates the sensory and motor nerves, and it is claimed by some to have an action similar to that of the high-frequency currents. When the static induced current is applied by means of the electrode designed by Morton, muscular contractions are produced when the electrodes are applied to the motor points, and also when placed along

the nerve trunks. It has some advantage over the faradic current, inasmuch as the application of the current is less painful.

#### THE SINUSOIDAL CURRENT

The sinusoidal current is simply an induced alternating current in which the alterations are extremely rapid, amounting to 1700 per minute in some cases. This current is obtained by means of a sinusoidal machine, consisting of a series of bodkins arranged concentrically around a revolving armature made of plates of soft iron. The bodkins consist of primary and secondary coils, the former being connected with a street current or with a number of cells, while the latter is connected with the terminal posts of a battery. By means of the revolving armature the primary current is rapidly interrupted, resulting in the development of a secondary current which produces contractions with less pain than the faradic current ordinarily employed. The primary current is best controlled by means of a water rheostat.

A very convenient generator of this current is designed by A. B. Kennelly.

Dr. J. H. Kellogg employs a magneto-generator to obtain the sinusoidal current which is wound for 50 volts and 3000 revolutions.

#### HIGH FREQUENCY CURRENTS

The apparatus employed by d'Arsonval consists of a condenser connected with a Ruhmkorff coil. The Ruhmkorff coil is capable of producing a spark of from 15 to 25 centimeters in length. This current is carried to the inner armatures of two Leyden jars, the external armatures of which are connected by means of a solenoid made of thick wire. At each discharge of sparks between the armature of the Ruhmkorff coil there is generated an alternating current of high frequency in the solenoid. This current is utilized by means of rheophores connected with the solenoid. The solenoid varies in size, and is sometimes large enough to envelop the entire body.

The current may be used by means of electrodes (Fig. 42) by which the patient is interposed in a shunt circuit.

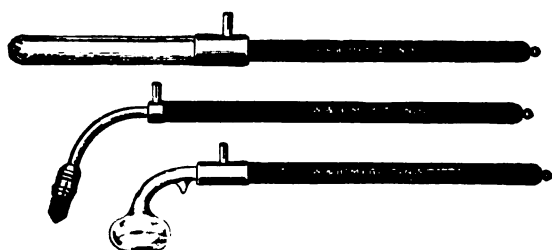


FIG. 42.—Electrodes for high frequency currents.

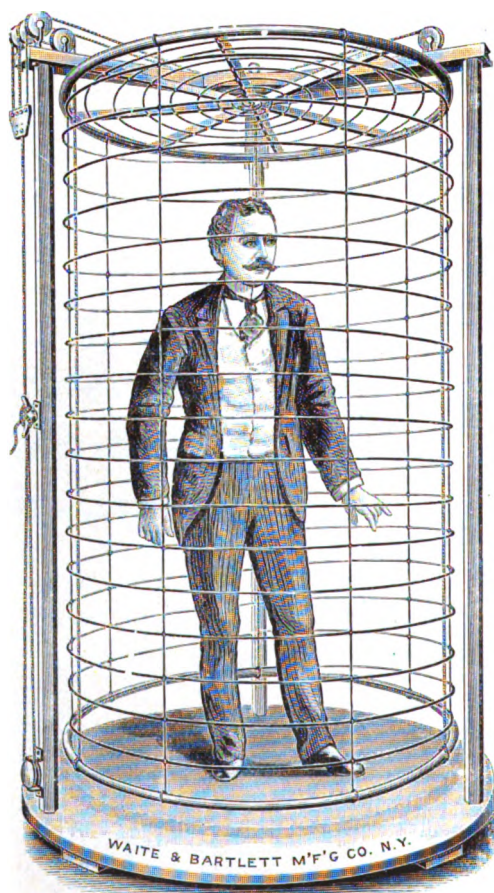


FIG. 43.—Resonator or combined spiral and solenoid.

It may be also used by autoconduction, which occurs when the body is placed within the solenoid without touching it (Fig. 43).

The third method of applying this current is by condensation. The patient is connected with a certain part of the solenoid, and thus forms an armature of a condenser, while the second armature is connected at another portion of the solenoid.

It is claimed that this current has induction effects, electrostatic effects, dynamic effects, and resonant effects. The induction effects are probably the most intense.

The electro-static properties are very similar to those obtained from the static batteries.

The dynamic and resonant properties will not be described as they have no direct relation to electrotherapeutics.

The physiologic properties of these currents, as described by d'Arsonval and others, are peculiar. The sensory and motor nerves are insensible to this current. It is said to have an inhibitory action upon excitability due to other causes; for example, local anesthesia lasting from one to twenty minutes, occurs at the point at which the current comes in contact with the skin.

Experimentally in dogs the arterial tension falls. After the application of this current the sensibility of the skin to galvanism and faradism is lessened, although more current can be given than before.

Some bacteriologic action has also been claimed for this current, and Dimitriewski claims that toxins become innocuous under its influence. Recent experiments upon tuberculosis in guinea pigs as claimed by Lagriffoul and Denoyés, demonstrate the disappearance of the process, as well as the bacilli.

Under the influence of the high-frequency current it is claimed that respiration is increased, and elimination of  $\text{CO}_2$  augmented.

In the direct application of the current the patient is connected by means of two large-handled electrodes attached to the ends of a solenoid. It is important to have the connection perfect, as otherwise small sparks will pass between the electrode and the skin.

In the labile method of applying this current the patient is connected with the solenoid, while the other end is attached to an electrode which is manipulated by the operator, who is able to treat



any particular part of the body desired. The current should be applied for a few minutes only.

*Auto-conduction* is given by means of a solenoid shaped as a cage in which the patient stands without touching it.

The auto-condensation method is given as follows: One end of the solenoid is connected with a long sheet of metal in the shape of a couch or a chair upon which the patient rests. The sheet is covered with cushions made of rubber waste which separate him from the metal. In his hands he holds two electrodes which are connected with the other end of the solenoid.

Local applications are also given by means of effleurvers. The sensation given by these electrodes is similar to that of the static breeze.

#### ELECTRO-DIAGNOSIS

In the study of the electro-diagnosis of certain nervous diseases we find that the muscles may show an increase, as well as a decrease, in excitability.

*Increased Excitability.* This is present in cerebral hemiplegia, brain tumor, dementia paralytica, tabes dorsalis, sometimes in myelitis, and the early stages of progressive muscular atrophy.

In the early stages of peripheral neuritis there is often an increase in electric excitability. I have observed in some cases of occupation neurosis a slight increase of the galvanic excitability. It is claimed by some that this is true also in some cases of chorea.

In tetany the increased electric excitability is readily demonstrated.

In Thomsen's disease there is increased faradic and galvanic excitability of the muscles but normal excitability of the nerves. The contraction of the muscles when the galvanic current is employed is slow and tonic, occurring at the closing of the current, and as strongly with the anode as with the cathode. With strong continuous currents sometimes a wave-like contraction is seen, beginning at the cathode and passing to the anode. Strong faradic currents produce wave-like contractions.

*Diminution of Excitability.* Diminution of excitability is found in peripheral neuritis, in mild cases of pressure neuritis, such as the drunk palsies, and in lead palsies.

Jacoby states that simple diminution occurs in many cases of atrophy following cerebral paralysis in which the peripheral neuron is not involved, and in cases of tract disease of the cord, in disease of the cerebellar peduncles, the pons, and medulla oblongata, and in amyotrophic lateral sclerosis. Simple diminution is observed in cases of pseudomuscular atrophy, and in progressive muscular atrophy. It is sometimes seen in the atrophy of disuse.

In myasthenia gravis pseudo-paralytica the muscles become readily fatigued so that a definite amount of current will cause at first a certain degree of contraction, but later, if the application of the current is continued, the contractions become weaker and weaker.

A peculiar electric phenomenon appears in those mysterious cases of periodic palsies which have been reported. I have examined three cases of this disease, and found the muscles absolutely unresponsive to all currents during the attack. In one case during an attack of palsy no muscular contractions were obtainable with the strongest faradic or galvanic currents that could be borne by the patient. This phenomenon cannot at present be explained.

*Reactions of Degeneration.* When muscles degenerate as a result of an interference with the nerve supply of the spinal cord they undergo the reactions of degeneration.

The first electrical phenomenon observed is a quantitative diminution in the excitability of the muscle to both the faradic and galvanic currents. Later, a qualitative change takes place, consisting of a failure of the muscle to respond promptly and quickly to stimulation. The contraction becomes wave-like, sluggish, and slow. Later, the  $\text{CaClC}$ , which is normally greater than the  $\text{AnClC}$ , gradually grows less and less until it equals the  $\text{AnClC}$ , and finally is less than the  $\text{AnClC}$ . When this occurs it is called the reaction of degeneration (De R). While the reverse of the normal formula expressed as  $\text{AnClC} > \text{CaClC}$ , is commonly looked upon as the reaction of degeneration, the slow wave-like response is characteristic of this condition, and may be accepted as pathognomonic, even when the formula is not reversed.

DeR is present in diseases of the peripheral nerves, motor roots, cells of the anterior horns of the spinal cord, and bulbar palsies.

In progressive muscular atrophy of spinal origin DeR may be found in isolated muscles, especially in the small hand muscles.

DeR may be found in bulbar palsies. In lead palsies DeR is found, and even may be present in muscles which have not yet been paralysed.

A knowledge of the situation of the motor points is very important, especially if it is desirable to study the paralysis of isolated muscles. Von Ziemssen and others have constructed charts indicating the positions of these points.

#### ELECTRO-PROGNOSIS

Electro-prognosis is of definite value, although it does not give us a great deal of information. When DeR is present it indicates, as has been said, certain changes in the muscle which will recover but slowly. If, at the end of two to six months, the muscles respond to the electric current it is reasonable to conclude that the case is one that may recover. The greater the electric excitability and the greater number of muscles which respond, the better the prognosis.

If there is a faradic irritability present the prognosis is more favorable, even if DeR is present. In cases of peripheral paralysis, such as facial palsies or traumatic palsies without DeR, recovery follows usually in about three or four weeks. If DeR is present the course of the disease is usually three to twelve months according to the intensity of the reaction of degeneration.

#### ELECTROTHERAPEUTICS

As has already been indicated, the therapeutic value of electricity depends upon several actions: (1) Its action as an irritant, or its exciting action by which the muscles are contracted and the sensory nerves stimulated, and by which the vasomotor system is influenced, and secretion is increased; (2) its electrotonic action; (3) its electrolytic effect; (4) its cataphoric action; and (5) its psychic or suggestive action.

George W. Jacoby<sup>1</sup> lays down a number of rules for the application of electricity, which are valuable guides in the application of this current. Before every application of electricity he em-

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<sup>1</sup> System of Physiologic Therapeutics, edited by S. Solis Cohen.

phasizes the importance of seeing that the current is turned off. The apparatus should be examined to see if it is in proper working order, and the least possible current turned on at first, the strength being increased gradually. It is a good habit to apply the electrodes to one's own hand before applying them to the patient. In applying the current to children it is well to apply the electrodes without the current for the first two or three seances. The current should be gradually reduced until it is entirely cut off before the electrodes are removed. The operator should always hold one of the electrodes in his hands, keeping himself in readiness at any time to turn off the current if necessary. It is well to avoid all unnecessary pain.

#### SPECIAL ELECTROTHERAPEUTICS

*The Peripheral Nerves.* Those diseases of the nervous system which indicate the application of electricity more than any others are diseases of the peripheral motor nerves. In cases of neuritis the application of the galvanic current is of great value. In the early stages, in which there is still inflammation of the nerves, associated with pain, the current should be applied in a different manner than when the acute stage is over, and the prominent symptoms consist of paralysis and wasting.

The galvanic current seems to reduce the severity of the acute symptoms when properly applied. In this stage the cathode electrode should be a large one, and should be placed between the shoulders, if the arms are to be treated, or over the sacrum if the legs are to be treated. A smaller anode electrode is then applied over the painful and inflamed nerves. The anode electrode should first be applied to the skin in a healthy region, and the galvanic current turned on until 4 to 8 milliamperes are registered. The electrode is then stroked slowly over the inflamed nerve. In other words, a labile ascending current of 4 to 8 milliamperes is employed.

In the treatment of the second stage of neuritis in which there is paralysis and DeR, it is best to apply an interrupted current, using that pole over the muscles which produces the greatest amount of contraction. This is almost always the anode when DeR is present.

The current is interrupted by means of an interrupting electrode, pressure being made upon the button interrupting the current by the index finger at regular intervals of two seconds. If the muscles respond to the faradic current it is well to supplement the effect of the galvanic current with the faradic current, which is applied in a little different way from the galvanic current. Both electrodes are placed over the muscle to be stimulated, and sufficient of the faradic current turned on to produce the maximum amount of contraction consistent with the endurance of the patient for the pain produced.

*Facial Palsy.* In the treatment of facial palsy the same rule should be observed as that above indicated. Until all acute symptoms have subsided no interrupted current should be applied to the distribution of the facial nerve. It is advisable to apply for the first month the anodal electrode over the district supplied by the paralyzed nerve, while the cathodal electrode is applied to the nape of the neck. The cathode pole should first be applied to the cervical region, 4 to 6 milliamperes of the current turned on, and the anode electrode then brought up to the face and the whole side of the face stroked slowly for 5 or 10 minutes. It is very important to avoid as much as possible those areas where the bone is superficial, and in stroking the forehead it is wise to reduce the current to about 3 milliamperes, gradually increasing it as the more fleshy parts of the face are treated. Sometimes, when the electrode passes over the mental foramen it causes considerable pain, and it is well to avoid this region with the electrode.

In the second stage, when the pain has practically subsided, and the acute inflammation is reduced, the current should be interrupted, employing that electrode over the paralyzed muscles which, when the current is interrupted, produces the greatest amount of contraction. This is usually the positive pole, and should be applied to the motor points of the face. The common motor point of the face is just in front of the tragus, and this should also be stimulated.

In *musculo-spiral palsy* the indifferent electrode is preferably placed between the shoulder-blades.

In traumatic cases, or in cases in which there is pain, the labile current is preferable, the anode being stroked along the inner

surface of the arm, over the course taken by the musculo-spiral nerve. For the treatment of the paralysis an interrupted current is indicated, using the anode over the muscle if DeR is present. If the muscles still respond to the faradic current the slowly interrupted faradic current should be applied over the motor points also.

In *pressure palsies of the arm*, or the so-called "drunk" palsies, there is rarely more than a slight diminution of the faradic irritability. These cases respond well to the slowly interrupted faradic current. The palsies which are caused by pressure from a crutch are usually more severe, and DeR may be present in the paralyzed muscles. In these cases of course the same rule is followed as that already indicated, namely, that the anode should be placed over the muscles and the current interrupted.

In *paralysis of the muscles of the leg* due to inflammation of the sciatic nerve, or its branches, the indifferent electrode is preferably applied over the sacrum, while the anodal electrode is applied to the motor points of the anterior tibial and perineal nerves.

In *cases of multiple neuritis*, during the acute stage, a large indifferent negative electrode is placed in the lumbar region, and a positive electrode with a diameter of five centimeters is applied to the inflamed nerve trunks, employing a labile current. Later, when the painful stage has subsided, the paralyzed and atrophied muscles are best treated with an interrupted galvanic current, always using the anodal pole over the paralyzed muscles in which DeR is present. The faradic current may also be used if any of the muscles still respond to stimulation by this current.

The *post-diphtheritic paralyses* rarely require more than the application of the slowly interrupted faradic current, which should be given to the motor points of the muscles affected.

*Paralysis of the ocular muscles* may be beneficially influenced by the application of the galvanic current in some cases. The anode pole is placed over the closed eyelid, and the negative pole at the back of the neck.

The treatment of spasmodic conditions by electricity is not very encouraging.

In *hysteric spasms* an ascending labile current is often of great value.

*Tic convulsif, blepharospasm, and torticollis* call for the appli-

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cation of electricity, although the results are not at all uniform, nor to be depended upon. It is best always to employ the labile ascending current, and, if this proves useless, a descending labile current may be tried.

In *occupation neuroses*, such as writer's cramp, piano-player's cramp, and the like, improvement follows in some cases the application of the galvanic current, and it should be used always in conjunction with other measures. The ascending labile current of three to four milliamperes gives the best results.

In *progressive muscular dystrophies* the application of electricity may be employed, but no one should hope to obtain any very encouraging results from its use.

In so-called *muscular rheumatism*, that is, the painful rheumatic states following the catching of a cold, electricity seems to be of great value. A galvanic current of five to ten milliamperes for from 5 to 10 minutes, and applied directly to the affected muscles, is always followed by great relief. The static spark or breeze proves useful in this class of cases also.

In *chronic rheumatic conditions of the joints* galvanism in large quantities, up to the point of endurance, favors the absorption of the exudate in the joint.

In *rheumatoid arthritis*, I believe the galvanic current, associated with massage and appropriate medication, has a remarkable influence upon the progress of the disease. If the current and the treatment are continued unflinchingly for a year or more, rheumatoid arthritis can, in some cases be cured. I have recently effected a cure in a case of this disease occurring in a woman of seventy-two, who was practically incapacitated for a year by reason of the rheumatoid changes in the joints of the knee, ankle, fingers, wrists and elbows. The galvanic current always relieved the pain at once for the time-being, but no marked improvement occurred until the treatment had been continued daily for nine months, when improvement rapidly took place, and three months later the patient was able to walk and used the hands and arms quite freely and without pain.

Electricity is of no use in the treatment of locomotor ataxia, except for the relief of the shooting pains. The positive electrode should be placed over the seat of pain, and the indifferent electrode

in the sacral region, or between the shoulders. Eight to ten milliamperes should be applied for eight or ten minutes. No effect upon the course of the disease can be expected from the application of the current along the spine, as is recommended by some electrotherapeutists.

In *exophthalmic goiter* the galvanic current should be applied in all cases. The results are not always uniform, but in many cases the treatment is followed by a sense of relief, and sometimes by a reduction in the pulse-rate. The indifferent pole should be placed at the nape of the neck, and the negative electrode stroked up and down the inner border of the sternocleidomastoid muscle. Four to six milliamperes should be used, and the treatment should occupy about eight to ten minutes. The negative electrode is then placed at the base of the heart, the positive electrode at the nape of the neck, and three to four milliamperes are applied for five minutes. The result of this treatment is often to reduce the rapidity of the heart. I have seen the pulse-rate reduced ten to twenty beats per minute by these means. In some cases, however, it seems to increase the pulse-rate, and instead of relieving the symptoms, actually makes the patient more uncomfortable. The treatment should be given once or twice a day.

The galvanic current is useful in certain diseases of the stomach and intestines. By means of a deglutible electrode (Fig. 14) dilatation of the stomach is beneficially influenced. The electrode should be attached to the positive pole of the battery, and the negative electrode placed over the left hypochondrium, or the rapidly interrupted faradic current may be used.

Percutaneous galvanism is also of some use, the anode electrode applied to the lumbar region, while an interrupting cathode electrode is employed anteriorly. The current is interrupted over the left hypochondrium and epigastrium, ten to thirty milliamperes being employed. The slowly interrupted faradic current is also useful when applied percutaneously.

Stewart highly recommended electricity in cases of subacidity and diminished secretion. In atonic conditions of the intestines, and in chronic constipation, the galvanic and faradic currents may both be employed with some benefit.

In the *hemiplegias* of cerebral hemorrhage, thrombosis and



embolism, faradism acts as a passive form of exercise. It is of some advantage in the treatment of contractures when the contracted muscles may be exhausted by the application of the strong faradic current, while mild currents are of value to stimulate the antagonistic muscles.

In *hysteria* electricity is useful both as a means of suggestion and by reason of its mechanical effects. Some manifestations of hysteria often disappear soon after the application of electricity combined with suggestion on the part of the operator. Hysterical aphonia is often cured by the application of the faradic or galvanic currents to the neck. An effective method for applying the rapidly interrupted current consists in applying one electrode to the neck, and immersing the other in water held in the back part of the mouth of the patient.

When electricity is applied as part of the regime of the rest-cure it is best given in the form of general faradism. Two small electrodes are applied to the main motor points of the principal muscles of the entire body, using the slowly interrupted current. After the various muscles are stimulated two large electrodes are used, one at the nape of the neck, and the second applied to the plantar surface of the feet, and the rapidly interrupted current allowed to pass between them. The entire treatment should occupy about an hour.

In the treatment of *neurasthenia* electricity plays an important part. It is an essential part of a complete rest-cure, and has almost as much value as general massage. As in hysteria, general faradism is indicated.

The static breeze is extremely useful in treating many of the fatigue sensations of neurasthenia. The neurasthenic headache or backache yields almost invariably to the application of either the breeze or the spark.

Static electricity is often a great comfort to the hypochondriacal neurasthenic, and is of great assistance in the treatment of many of the bizarre symptoms of which neurasthenics alone complain.

*Insomnia* in neurasthenia is sometimes helped by the mild stable galvanic current applied to the nape of the neck, or the rapidly interrupted current applied in the same region.

The static breeze applied by means of the crown electrode produces beneficial results in many cases of neurasthenic insomnia.

*Treatment of Diseases of the Special Organs of Sense.* In opacities of the cornea the galvanic current has been recommended by some authorities. In a case that I treated for Dr. DeSchweinitz there did not seem to be any improvement after six weeks of daily treatment.

In the treatment of papillitis or choked disc the galvanic current does not seem to have any beneficial influence. In optic neuritis a mild galvanic current should be employed, placing the negative electrode at the back of the neck, and the positive pole over the closed eyelid.

In toxic amblyopia, or hysteric amaurosis, the galvanic current should always be employed, and the results are most satisfactory. It should be applied in the same manner as in optic atrophy.

In diseases of the auditory apparatus the galvanic current does not have much value.

*Psychic States.* Electricity should be used with great caution in the treatment of cases of insanity. While many recommend its use in almost every form of insanity, the results of its employment do not warrant placing much dependence upon this form of treatment. It has the disadvantage of sometimes suggesting unpleasant delusions, and is contraindicated in those cases of melancholia with intense phobias.

*Electricity in Gynecology.* Electricity in gynecology is employed for the relief of chronic endometritis, inflammatory exudates in the pelvis, certain varieties of fibroid tumors, dysmenorrhea due to subinvolution, and displacement of the uterus. In chronic metritis and endometritis a current of from ten to twenty milliamperes is employed, with the negative electrode in the uterine cavity, and the positive electrode over the abdomen. Others advise the positive pole in the uterus. Treatment should be continued for five minutes, two or three times a week.

In pelvic inflammatory exudates of recent origin absorption is said to take place by the prolonged use of galvanism. The negative electrode should be inserted in the vagina, rectum or uterus, employing thirty to fifty milliamperes. Treatment should be given three times a week, and extended over several months.

Franklin H. Martin advises electricity in (1) bleeding fibroids occurring in women around the menopause; (2) in patients that cannot be operated upon; (3) in incipient fibroids occurring in women over forty years of age; (4) in bleeding and smooth interstitial fibroids which exhibit no symptoms besides the hemorrhage; and finally (5) in all cases in which consent to an operation cannot be obtained, and in which there is no accumulation of pus.

Cervical stenosis with dysmenorrhea is often relieved by the application of the galvanic current. A bipolar uterine electrode may be used for this purpose, the tip of the electrode affecting the body of the uterus, while the cervix may be affected by the second portion of the electrode. The faradic, sinusoidal, or galvanic current may be used.

In the nervous forms of dysmenorrhea the galvanic current is employed with the positive pole inserted in the uterus, and the negative pole on the abdomen. An abdominal plate should be composed of clay and placed over any painful portion of the abdomen that may be complained of. Fifty to one hundred milliamperes may be employed for five or ten minutes every day.

#### CATAPHORESIS

This principle of electricity has been employed, although the amount of drugs that can be absorbed into the system by this method must certainly be very small, and the action of the drugs therefore restricted. As a local anesthetic in neuralgias or in minor operations it has some value. It has also been recommended in the treatment of rheumatic, gouty, and syphilitic affections, as well as in tuberculous disease localized to small areas. It has also been suggested as a method of giving the electro-cataphoric bath.

#### SURGICAL ELECTRICITY

The use of electricity in surgery consists largely in the application of cauteries, or as a diagnostic agent, by means of the electric cystoscope, endoscope, gastroduaphanoscope, the esophagoscope. The galvano-cautery has been employed in the treatment of diseases of the lung and the cervix of the uterus. It may be employed in the treatment of vascular or polypoid growths which, on account of their position, are difficult to operate upon by ordinary methods.

In the treatment of laryngeal ulcers and growths of the pharynx and larynx it is very useful. It is also employed to influence chronic ulcers and nævi.

The electric treatment of prostatic hypertrophy, as suggested by Bottini in 1877, seems to have been recommended by some surgeons. It consists of burning furrows in the gland.

#### ELECTROLYSIS

When both poles of a galvanic battery are applied to organic substances there is a coagulation at the positive pole, and a liquifaction at the negative pole. This is called electrolysis and is principally made use of in the treatment of tumors, nævi, etc.

Special electrodes are necessary in the employment of electrolysis and should consist of gold, platinum or steel, insulated to a short distance of their tips. The treatment may be either monopolar or bipolar. In the monopolar treatment a large indifferent electrode should be placed between the shoulders, and the active electrode should be applied to the area which it is desirable to influence. In the bipolar method both needles are plunged in the tissue.

The amount of current varies according to the conditions, and the duration of the treatment. In treating aneurysm, varicose veins, nævi, goiters, hemorrhages into the skin, and similar conditions, the monopolar method should be employed, the anode being used to influence the diseased area. In the removal of superfluous hair, warts, moles, cicatricial tissue, etc., the monopolar method should be employed, with the cathode at the diseased area.

# THE PREVENTION AND TREATMENT OF CHRONIC NEPHRITIS

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EVERY advance in the study of the pathologic physiology of chronic nephritis takes us farther away from the kidneys and deeper into the still hidden processes of metabolism. All forms of this disease, in fact, are so closely related to these processes in their etiology and symptomatology that, it seems to me, we might almost describe chronic nephritis as a condition of abnormal or defective metabolism. The condition is not the same in all cases, neither are the consequences the same. The disturbances of nutrition, the toxemia, and the derangements of cardiac, vascular, and renal functions are the manifestations of them; the destructive changes in the affected organs are their results. It is only in some such conception of the disease as this that we have a basis for effective prophylaxis or hopeful treatment. It is only when the morbid processes are still functional that we can ever expect to effect a cure; but, like other organs, the kidneys, when moderately diseased, are capable of carrying on their work indefinitely to an extent that renders life supportable, provided that they be freed from the irritation that is causing their destruction.

Three sets of phenomena are now distinguished in cases that were only a short time ago embraced by the term chronic nephritis. These are renal irritation, renal insufficiency, and nephritis. "These three sets of changes are frequently associated," R. C. Cabot has recently said, "but the association is by no means invariable, and if we try to infer from the one the presence of the others, we are bound to fall into error. Renal irritation or insufficiency may exist without nephritis—for instance, in passive congestion of the organ—and we may have nephritis without evidence of irritation

or of insufficiency. Renal irritation and renal insufficiency, acute or chronic, are what we want to recognize and to treat."<sup>1</sup>

The presence of albumin and casts does not indicate more than renal irritation. The albumin may be in large or small quantity, the casts may be many or few, and more or less blood, pus, or renal epithelium may accompany them, just as in acute nephritis, yet there may be no structural alteration in the kidney.

By renal insufficiency (the renal inadequacy of Sir Andrew Clarke) is meant an inability of the kidney to do its work, an inability to excrete enough water, or the products of nitrogenous metabolism, or the inorganic salts. This loss of power may be indicated in the functions of other organs, in dropsy, uremia, or changed vascular tension with hypertrophy or dilatation of the heart. The changes in the urine are those of its physical character, the 24-hour amount, the proportion of night urine to day urine, the weight and color. Time is recognized as the significant feature in the distinction of renal irritation and insufficiency from nephritis; but what the time limit is probably no one can tell. We can see in the irritation an approaching parenchymatous change, and in the insufficiency a threat of sclerosis, but the knowledge that either condition may remain indefinitely as a functional defect is an aid to treatment. There can be little doubt that, in many instances, it is possible to anticipate and more or less permanently prevent structural changes by heeding the warning that is given by the discovery of functional insufficiency. I believe, too, that there are conditions in which renal insufficiency is indicated, for a time at least, by an absence of pathologic features in the urine as ordinarily tested. And it is in cases of this character that the physiologic tests are of the greatest service.

One of the principal functions of the kidney, perhaps, is the formation of uric acid from its antecedent proteid, a product of metabolic action brought to it in the blood. An excess of uric acid beyond the quantity that can be converted immediately into urates is exceedingly irritating to the kidney. The antecedent is a toxalbumin of variable toxic power. Whether or not the type of renal lesion is influenced by its isomeric form, it probably bears a relation

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<sup>1</sup> New York Med. Jour., 1906, lxxxiii, p. 962.

to chronic nephritis which is comparable to that of the scarlet fever toxin to acute nephritis. It is not only a frequent cause, but it may be regarded as the type of other causes.

#### PROPHYLAXIS

To prevent the causal derangement of metabolism, or to correct it after it has become apparent in renal irritation or insufficiency, is to prevent nephritis. In some cases, of course, the renal condition is traceable to an antecedent infection, but more commonly there exists a more or less definite autointoxication. To discover the cause of this and to remove it necessitates our getting a full knowledge of the inner life of the individual. What does he eat; how does he eat, and when? What are his habits in regard to work and rest?

It is commonly said that most people eat too much. It seems to me that a better version of the same truth would be that most people consume too little. The farmer and the mechanic eat enormous quantities of food, as a rule, but they consume what they eat. Their kidneys rarely fail them, for they breathe normally, their blood is well supplied with oxygen, and they obey the demands of nature for rest. Their waste products are those of completed metabolism, not those of stagnation. We should insist, therefore, on greater activity among people of the classes "above" the toilers, and let the appetite govern the quantity of food. To exercise spasmodically in a gymnasium once or twice a week is no doubt better than not to exercise at all, but daily, purposive work in the open air is much better than gymnastics. Exercise in a room with the windows closed is little less than suicidal; yet I have seen more than fifty men working hard, under a so-called instructor, in a gymnasium heated by steam and absolutely without ventilation. People should be taught that the danger of drafts is overestimated. Drafts are harmful chiefly when too little air is let in. The people who sleep in tents, on roofs and at open windows, escape the minor infections attributed to cold and the intoxications caused by foul air. Exercise should always be taken out of doors or with wide open windows, and as a rule it should not stop short of a slight feeling of fatigue, providing that the person is in health. Warnings against moderate fatigue are only for the invalid.

Fatigue is a state of self-poisoning, however, an acid intoxication, perhaps, that necessitates an increased elimination by the kidneys and quickly produces irritation when carried to extremes. The clinical history of many cases of chronic nephritis favors the assumption that disregard of fatigue may become a source of fixed renal lesions. We ought to insist, therefore, that work, whether physical or mental, must be kept within safe bounds and that it must be compensated for by sufficient rest to permit the removal of the toxic matter in the manner that nature has provided for the purpose. This includes abundant sleep at night and one day of rest in every seven.

The kind of food people eat should be adapted to their personal needs, and these vary with work, climate, season, and other circumstances. Excess of nitrogenous food should be avoided, but the danger of such excess is greatly reduced when the alimentary functions are normal. The shocking exposures of filthy methods in certain slaughter houses and beef-packing establishments had, for a short time at least, a desirable influence in reducing the consumption of canned meats, and until the use of such preservatives as boric acid and formaldehyde in foods has been stopped or regulated, people should be encouraged to abstain from such preparations. It seems also that there is room for more complete investigation of the effects on digestion and nutrition of the modern methods of killing, chilling, and keeping of meats for an indefinite time in cold storage.

Next for consideration after proper food is normal digestion. As an aid to this the food must be completely masticated, correct in quality and quantity, and eaten at intervals which allow the gastric and intestinal muscles a period of rest. Neither the stomach nor the other organs of digestion can perform their functions fully while constipation exists, and there is no more prevailing evil perhaps than this. But constipation is for the most part one of the results of indolence. To overcome it by the daily administration of drugs generally makes matters worse. Better results are obtainable from correct diet, including an abundance of fruit, exercise, and the drinking of plenty of water. If more must be done, enemas are to be preferred, and a small quantity of cold water is often better for this purpose than a large quantity of warm water. Too often the condition that perpetuates the constipation is overlooked. Hemorrhoids, for



example, with spasmodic contraction of the anal sphincter, although possibly a result of the constipation, will effectually prevent the cure of it by any method of treatment which does not include their removal. To remove autointoxication requires first of all regulation of the bowels. We must not neglect to examine for nephroptosis and other organ displacements, too often discovered after years of suffering; next to these, or possibly more common, are the many reflexes from the other organs, all of which are possible causes of autointoxication through perversion of nutrition. Sometimes the liver is at fault, or its action has become deficient, and such remedies as calomel, sodium salicylate, phosphate, or glycocholate may be employed with benefit. The popularity of ready-made drugs has unfortunately led many busy physicians into the habit of dispensing the rarely needed digestive ferments instead of antagonizing the cause of the disorder.

The use of alcohol and tobacco is probably too little considered as a factor in renal irritation. There is no doubt, I think, that the man who indulges in alcoholic beverages of any kind to any extent is more exposed to the danger of nephritis than the abstainer. The action of the alcohol on the kidneys is probably not direct, but through disturbance of the functions of the stomach, liver, and organs of circulation. When renal irritation is recognized in such a person, the advice to stop drink should be positive and emphatic. The results of the experimental study of the action of tobacco by different investigators have been contradictory to some extent. They seem to indicate that the action of the poison on rabbits, just as on men, is largely influenced by personal idiosyncrasy. Men who notice a diuretic effect from the smoking of a strong cigar should be advised against the practice. That the tobacco heart is closely related to arteriosclerosis and the attendant kidney changes is at least probable. Other poisons influential in the production of renal irritation are lead, arsenic, mercury, phosphorus, the toxic products of malaria, tuberculosis, syphilis, gout, rheumatism, chronic suppuration.

Disregard of the hygiene of the skin is doubtless a common cause of renal irritation. It is not only the neglect of bathing, but in many, possibly in most cases, it is the wearing of too heavy, close, warm clothing by persons in health. If people could be taught to

begin the day with a cold shower or sponge bath and a vigorous rub down, to wear clothing that is no warmer than comfort requires, and to put on lighter garments in-doors and on warm days than out-of-doors and on cold days, the action of the skin would be more uniform, and chilling of the surface would be responded to by increased flow of blood in the cutaneous vessels and not by driving it away from them. No person, perhaps, appreciates more than the nephritic patient the feeling of comfort that is afforded by the stimulation of cutaneous circulation following a bath and friction, but it is not usually advisable to insist upon immediate reforms in the habits of dress after the renal functions have begun to fail.

Great care should be exercised during the administration of drugs that are capable of irritating the kidneys, and occasional tests of the urine should be made when it is necessary to prolong their administration. Reference was made to some of these drugs in relation to acute nephritis in a previous article.<sup>2</sup> A few others should perhaps be referred to, although their relation to nephritis is only problematical. An almost entirely overlooked source of injury to the kidney, I believe, is the irritation caused by the excessive administration of strychnin. The tonic dose is too often exceeded in an effort to make the patient "feel good." An enormous quantity of strychnin has been consumed in tablets, proprietary and patented medicines, during the last ten or more years, while arteriosclerosis has been attracting a correspondingly increased attention. The theory of Harper and others that urea is antagonistic to the tubercle bacillus suggests the possibility that creosote may owe part of its beneficial action in tuberculosis to the production of a renal insufficiency. Most of us no doubt have noted, during the administration of the drug, a stimulation of renal action, as indicated by nocturnal urination, and it is my misfortune to have seen a few cases in which this irritation was followed for a long time, after the taking of large doses, by albuminuria much more profuse than ordinarily occurs in connection with pulmonary tuberculosis, without any other symptoms indicative of tuberculous involvement of the kidney. In this and in all other chronic diseases, as malaria, rheumatism, syphilis, the prolonged use of such drugs as mercury,

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<sup>2</sup> INTERNATIONAL CLINICS, 1906, 16th series, vol. ii, p. 17.

iodine, quinin, should be safeguarded by periodic examinations of the urine.

#### TREATMENT

The first step toward the treatment of a case of chronic nephritis should be, (1) to discover as nearly as possible the form of the disease and the stage it has reached, (2) to ascertain the cause, and (3) to determine the extent to which the kidneys are able to do their work. In reaching the diagnosis, the general condition of the patient, his color, weight, whether stationary or fluctuating, his strength, circulation as to tension and rate, his respiration, tongue, odor of breath, digestion—all these things must be taken into account, as well as the character of the urine. All extraneous forms of albuminuria must, of course, be excluded. In a mild case, enough can often be learned of the urine from a series of examinations of 24-hour specimens, but in a case showing much evidence of renal insufficiency or irritation, other tests should be made. The patient should be required for the time to refrain from exercise and to adopt a fixed diet, preferably restricted to milk, toast and cereals. After the action of the kidneys has been investigated under these conditions, the influence of a more liberal diet can be determined by an examination after the addition of each class of foods, more particularly the albuminous, and after increased drinking of water and the ingestion of an excess of sodium chloride. While this investigation is going on the condition of the patient is often improved by the rest and restraint; having completed the investigation, we are ready to treat the condition.

It should be our effort, (1) to remove the cause of the renal condition as far as it may be possible, (2) to bring the metabolic processes of the body down as nearly as possible to the standard of renal efficiency so that the work of elimination may be within the remaining functional power of the kidney, (3) to improve metabolism and assist the kidney by sustaining the physical and mental vigor of the patient, stimulating other sources of elimination whenever it becomes necessary, and (4) to relieve unfavorable conditions as they arise.

The point on which I desire to lay most stress is the importance of treating all patients who come to us with signs of renal irritation or insufficiency from the etiologic side of the condition and not the

pathologic, offering them the hope of recovery from a functional disorder as long as such hope can be consistently entertained. It is the gloomy prognosis so constantly pronounced on persons with albuminuria that drives them to the charlatan who freely boasts of his cures, and it is the frequent recovery of such patients from mere functional disorders that supports the claims of cure.

Every patient must be treated individually. The diet should be as liberal as the conditions will tolerate, but personal peculiarities require that a distinction be made in the quality, quantity, and frequency of meals. Certain general rules must be observed, especially with regard to nitrogenous food, but no fixed rules are applicable to all cases. The exclusive milk diet should be reserved for the worst cases, with irritability of the stomach or symptoms of uremia. It is useful, however, at longer or shorter intervals during treatment, whenever the nitrogenous waste products seem to be accumulating in excess of the power to eliminate them, and to overcome the effects of indiscretions on the part of the patient. Butter-milk or one of the fermented preparations is often better at such times than sweet milk.

Most authorities agree that a small portion of meat may be eaten once a day. The allowance must be granted and regulated, however, by the effects. If, after an exclusive milk diet, a resumption of meat fails to increase the output of nitrogen in the urine, or if it increases the nervous manifestations, it is an indication to withhold albuminous food, and the prohibition must sometimes include eggs and vegetables rich in nitrogenous matter. If this rule is not observed, the patient often seems to tolerate the liberal diet for a time, but he generally acquires a gradual intoxication culminating at shorter or longer intervals in attacks suggestive of uremia. It is not uncommon on the other hand, to find patients who have been so impressed with the necessity of rigid dieting, more especially those who have studied the alarming statements in patent medicine circulars, that they are reduced to extreme weakness, and it is often difficult to persuade them that a more liberal diet is safe. Sometimes indeed it has become unsafe through the exhaustion of vitality for want of it. Well-cooked vegetables and farinaceous articles can generally be eaten without restraint, and simple salads, as lettuce, with pure olive oil, are nutritious. But

cabbage, tomatoes, asparagus, turnips, cannot be eaten freely by all persons. Oranges, grape fruit (shaddock), and other citrous fruits are usually of benefit, but astringent fruits and some kinds of grapes should be allowed with caution. The use of spices and condiments, especially pepper, mustard and horse-radish, must be restricted. It is often necessary to caution the patient against too free indulgence in articles of which he is excessively fond, although they are not harmful in moderate quantity.

The salt-free diet is without doubt a valuable aid to treatment, more particularly in cases attended with edema and when the weakened heart is struggling against a similar burden due to beginning sclerosis of the arteries. It is hardly probable, however, that the correct application of it has been fully determined. Almost any desirable degree of dechloridation can be obtained through regulation of the diet, withholding added salt and restricting the use of foods that naturally contain it. The relative importance of different articles in this connection was given in the article of Barié.<sup>3</sup> Milk, fruits and most vegetables are for the most part unobjectionable in this regard; but sweet butter should be used, and baked potato is better than salted bread. But at best the withdrawal of salt is only a palliative measure; it is not curative, and the distress to the patient in having to devour tasteless or unnaturally flavored food should prevent unnecessary trials of the method. It is a well known fact also that cattle, sheep, and probably all the lower animals, soon become scrawny and weak when deprived of salt. The same is true of man, and strength once lost by the nephritic patient is seldom regained. The privation should not, therefore, be carried beyond the necessity of the case.

The amount of liquid to be taken should be determined by the need of it more than by the thirst. The conditions to be guarded against are an overfilling of the blood-vessels, which throws more work on the heart than it can do when the kidneys are deficient, and the opposite condition, in which enough water is not provided to maintain the secretions. When the kidneys respond to tests of efficiency in the elimination of water, the allowance should not be reduced below that of health. But it is necessary to withhold

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<sup>3</sup> INTERNATIONAL CLINICS, sixteenth series, vol. i, p. 260.

water to a certain extent for the relief of edema and whenever elimination is much reduced. The diuresis attending interstitial nephritis is necessary, however, and should be supported. The need of liquids is not generally so great in any case as to tax the ingenuity of either the patient or his physician. Pure water, lemonade, tea, coffee, milk, sour milk, buttermilk, fermented milk; these are usually sufficient. Alcoholic patients and those accustomed to a little wine or liquor at meals generally give them up reluctantly, and these are the patients, if any, who do better when a moderate indulgence is granted. The physician should assume the least possible responsibility in the matter; for, unless he positively forbid the use of alcohol, he cannot hold himself altogether blameless when the patient exceeds the limit, as he invariably will do from time to time. The question should not be, What can the patient tolerate, but, What can he do without. If a little alcohol is thought to be needed for the appetite or digestion, it can be given as medicine, disguised with a bitter tincture, more safely than in the form of a cocktail. Excessive drinking of tea and coffee should be guarded against no doubt, but a cup of hot, strong coffee often has a desirable effect on the circulation. Cocoa is an appropriate beverage in dropsical cases, since it favors the elimination of chlorides.

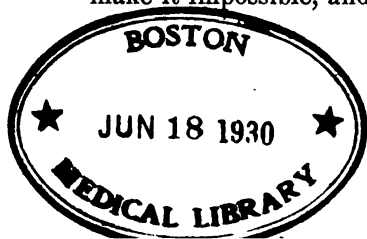
Whatever may have been the custom of the patient before his illness, he should now practice systematic bathing. Some persons feel better when they continue to take their accustomed morning cold bath, but others do better to abandon it, owing to dyspnea, palpitation or failure of the skin to react. A hot bath, ranging from 100° to 110° F. (37.8° to 40° C.), the duration correspondingly long or short but not exceeding twenty minutes as a rule, should be taken twice or thrice a week, preferably at night. An occasional Turkish bath may be of benefit. Everything must be governed by the effect. When diaphoresis is mostly desired, a hot bath of short duration, at 104° F. (40° C.) or higher, should be followed by wrapping the patient in blankets and putting him to bed, or a hot-air bath may be employed. The more frequent the bath, the more moderate should be the temperature; the greater the need of elimination, the higher it should be, as a rule. Every precaution must be taken to avoid chilling in the transfer of the patient from bath to bed. Good results have been obtained recently from daily

tepid baths an hour or an hour and a half in duration. The temperature of the water must be kept from falling.

Most writers state that the patient should wear warm clothing and that he should keep woollens next the skin the year round. My impression is that it is safer not to do either of these things, but to conform as closely as possible to the changes of atmospheric temperature. The danger of chilling is always greatest when the clothing is too warm, and in warm weather the healthy action of the skin can be maintained better by wearing a loosely woven linen or cotton garment next it. In places where the evenings are cool, the patient should stay indoors. When it is possible to reside in a climate where the changes of temperature are slight, he does best with only enough clothing to protect him from the wind. Outdoor life should be insisted upon.

One of the most difficult problems in the treatment of many cases is that of exercise and rest, for two antagonistic requirements have to be fulfilled. The muscles must be given work or they undergo extreme atrophy and the patient becomes bedridden, but the insufficiency of the kidneys and the weakness of the heart demand much rest. Nothing is more necessary than to retain the integrity of the heart as long as possible. The exercise should be exceedingly light, such as walking, rowing, or passive movements. The limit should be the production of slight perspiration (a very desirable result when it can be obtained), shortness of breath, rapid action of the heart, or the least perceptible fatigue; and abundant rest must be taken to compensate for the exercise that has been taken. Of even greater importance, however, is entire mental rest. Worry and nervous excitement are more injurious than physical overwork, and they are the chief factors in hastening the decline in many patients. Massage is all that can be tolerated by some persons, on account of the ease with which renal irritation is produced, even the mildest exercise causing an increase in the output of albumin. Sometimes the rapid or irregular action of the heart after slight overexertion requires rest in bed for several days, to restore its rate and rhythm, and medication may be necessary.

Routine medication is seldom advantageous in the treatment of chronic nephritis. The sudden changes that occur in many cases make it impossible, and more good can be done as a rule by meeting



conditions as they arise. Probably the nearest approach to continuous medication should be made in the administration of cathartics, for there is no better means of preventing the accumulation of toxic matter and consequent renal irritation. The most suitable cathartics are the salines. These may be given in simple solution, in an effervescent draught, or in the form of any natural mineral water which does not contain an excess of chlorides or other harmful ingredients. Constipation must not be permitted to occur even periodically. Calomel should not be employed too frequently, however, for to some persons it is a kidney irritant in very small doses.

When the blood circulation begins to be affected, it usually becomes necessary to prescribe something for its restoration, but not so uniformly as was formerly the custom. A slight increase of arterial tension is a compensatory change when the kidneys are inefficient, and if this tension be removed the inefficiency is increased or irritation may be produced. When, however, the increase of tension becomes harmful, and if it be due solely to hypertrophy of the heart with inelasticity of the arteries, it should be temporarily modified, and further interference can then be decided upon from the result. Increased tension in an inelastic radial artery does not always indicate an equal disturbance of the kidney circulation, for the firmness of the arteries in a general condition of sclerosis greatly retards the flow of blood to the periphery, and nervous influences often modify the local conditions. If the renal state is due to the action of toxic matter in the blood, the poisoning is only intensified by the administration of drugs which do not remove the cause of it. A brisk cathartic often takes away the apparent need of so-called heart remedies.

Nitroglycerin has long been the favored remedy for the relief of increased tension, and it is generally the best when an immediate effect is desired, but its action is so evanescent that it must be administered frequently or it must be supported by other drugs, as citrated caffein or sodium or potassium nitrite. By opening up the peripheral vessels, it gives the heart a moment's rest, similar to that which the heart often takes by skipping beats. The mode of its administration is well understood. No attempt should ever be made to bring the arterial tension down to the standard of health, however, for renal insufficiency is favored and uremia or edema



may ensue. Nitroglycerin does not always modify the quantity of albumin in the urine. Caffein should be given in full doses when it does not cause nervous excitement. Erythrol tetranitrate and other remedies have been praised of late by various writers as substitutes for nitroglycerin. The iodides, of which the sodium or strontium salt, I think, is to be preferred, sometimes exercise a remarkable influence in relieving arterial hypertension, but the quantity given should be as small as possible, and the influence on the kidneys should be closely watched, for irritation is sometimes produced. A history of syphilis may justify a trial of comparatively large doses, but it does not always insure a beneficial result.

Strontium lactate has sometimes a distinctly beneficial action in reducing the quantity of albumin and assisting elimination, but it often fails to do any appreciable good.

When the arterial tension is low and the heart's action is becoming weak, digitalis is generally the best remedy. This limits its usefulness in great measure to the cases in which the renal parenchyma is chiefly affected, cases in which the elimination of water is deficient, and more especially those characterized by edema. Sometimes the desired effect is obtainable from a combination of digitalis and strophanthus when it cannot be got from digitalis alone.

The remaining indications for drug administration are usually associated with acute exacerbations and are the same therefore as in acute nephritis; these, so far as I understand them, were reviewed in another article.<sup>4</sup> Anemia, the varied manifestations called uremia, and many of less severity, often require special treatment, but the careful management of a case according to the methods that I have tried to outline will often postpone for a long time the stage of the disease at which all our efforts must fail, and if life is not lengthened, it is at least made more tolerable.

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<sup>4</sup>INTERNATIONAL CLINICS, 1906, sixteenth series, vol. ii, p. 17.

# THE ETIOLOGY AND TREATMENT OF CHRONIC CONSTIPATION

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IN chronic constipation, more than in most other affections, it is of the greatest importance to base the treatment upon an intelligent study of the morbid physiology of the process. The only proper way to remedy the disturbance of function is by the study of the various conditions under which constipation can arise; for constipation is a symptom common to a great variety of morbid states. It occurs in intestinal spasm, in atony, in obstruction, and also in the various disturbances of digestion and absorption that I am about to discuss in detail. It will be seen that a proper diagnosis of the cause of constipation is absolutely essential for its intelligent treatment, because remedies that will help in one form will often do damage in another.

It is always difficult to compare the frequency of the occurrence of diseases from one generation to another, but it does seem as if constipation is increasing and extending. The conditions of modern life are such that this is to be expected rather than otherwise. The increased facilities for transportation interfere with proper exercise, and the rush of modern life often leaves no period in the day for regular going to stool. Thus we encourage muscular weakness and derange the habit that is a most important part of the mechanism of regular evacuation of the bowels.

It is needless to remark that the character of our food plays an important part in the etiology of constipation. This fact has always been recognized, whatever has been the theory of the mechanism of its causation. The recent work of Schmidt and Strasburger has shown that the way in which the character of our food influences the action of the bowel is quite different from what has been generally supposed. We have always thought that the direct cause of what

has been called atonic constipation, was weakness of the wall of the intestine. However, Schmidt and Strasburger have shown that this form of constipation is due, not to atony of the muscle, but to too complete digestion and absorption of food in the intestine. As a consequence, the intestinal bacteria have not food enough left for their growth and; therefore, they cannot form the various substances, such as gas and acids, which appear to be normal and necessary stimuli to the intestinal wall, and the intestine lacking this stimulation fails to work properly. Thus, the eating of well cooked and easily digestible foods to the exclusion of all others would increase the tendency to chronic constipation of this type, and another reason why modern conditions favor constipation may be found in the fact that knowledge of scientific cooking is becoming more widespread and must have considerable effect upon the diet of our urban population. There are cooking schools in most of the endowed trade schools, and in some public schools, and the cooking departments in the newspapers and women's journals are gaining in importance. All of these educational agencies lay considerable stress upon the digestibility of food and its preparation so as to be digestible—whereas, in the cook books of our ancestors, the savoriness of a dish was its chief, if not its only recommendation. This tendency to greater attention to the digestibility of food may well be one cause for the increase of constipation. Moreover, the physical character of the foods themselves probably play some part; such as roller flour, the various cereal foods that have been thoroughly cooked before being exposed for sale, and the use of vegetables canned when they are young and tender instead of being preserved by drying.

**THE RATIONAL TREATMENT OF CONSTIPATION.**—The best among the text book writers emphasize several important points in the treatment of constipation: (1) That constant use of strong cathartics is certainly not the way to treat chronic constipation; (2) that diet, regulation of habit, and exercise are the best ways of combatting it; and (3) that infrequent evacuations are often consistent with perfect health. We will, I think, all acknowledge the truth of these axioms. Still, to those of us who practice medicine, chronic constipation remains one of the most trying conditions that we are called upon to treat because (1) the prescribed diets gen-

erally fail to do what is expected of them; (2) regulation of exercise and habit are exceedingly difficult to enforce in busy patients; and (3) it is almost impossible to convince our patients that they exaggerate the results of constipation. Especially is the last true in the treatment of neurasthenia. Therefore, we must welcome the scientific study of the causes of constipation and the attempts to develop a rational treatment based upon the morbid physiology of the condition. Let us first see upon what evidence the theory of Schmidt and Strasburger is based.

*The Character of the Stools in so-called Atonic Constipation.*—Schmidt<sup>1</sup> has studied a large number of cases of this so-called atonic form of constipation, and has found that the stools are not only poor in water but also that the dried weight of the fecal matter passed in constipation is decidedly less than in normal persons. At the same time microscopic examination shows that there is an extraordinarily small amount of food remnants in the feces. I have studied a number of cases of constipation and can confirm Schmidt's statements, especially as to the overly perfect digestion and very small amount of food remnants. Such stools consist almost entirely of granular debris and bacteria. In considering this last statement, it must be remembered that quite a large part of normal stools consists of bacteria.

Strasburger<sup>2</sup> has shown that the total amount of bacteria in the feces of chronic constipation is much smaller than normal; only about two-thirds as much. The significance of this is striking in its bearing upon what I have said concerning the harmlessness of moderate constipation.

Lohrlich,<sup>3</sup> on Schmidt's suggestion, has undertaken a systematic investigation of the stools of cases of constipation passed while the patients were on the test diet. He found that the normal dried weight of the stools of the three days' diet, averaged 59.3 grams; while in constipation it averaged but 33.9 grams. This indicates that digestion and absorption had been too perfect.

The effect of opium is to inhibit peristalsis and when it is given a condition simulating atony of the bowel is produced, approaching

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<sup>1</sup> Münch. med. Woch., 1905, No. 41.

<sup>2</sup> Ztschr. f. klin. Med., 1902, 46.

<sup>3</sup> Deutsch. Arch. f. klin. Med., 1904, 79.

what we have supposed to be the condition in so-called atonic constipation. However, Lohrisch and Schmidt found that when they gave opium to normal persons, the watery elements of the stool *only* were reduced, while the dried substance was not altered. This indicates quite strongly that lack of peristalsis cannot of itself produce the condition that we have called atonic constipation. No doubt weakness of the bowel muscle plays some part in the production of constipation, but, as Schmidt says, it appears to be not the most important factor.

The principal causes of so-called atonic constipation then are too perfect digestion and absorption of food, the poor growth of the normal bacteria of the bowel, and the consequent lack of the products of fermentation which are the normal and necessary stimulants of peristalsis. Another characteristic of constipated stools which I have often noted, is the absence of vegetable detritus although the diet may contain at the time considerable fibrous vegetable material that is normally found in the feces almost unaltered. Schmidt explains this by the supposition (and I confess it appears to be merely a supposition) that the intestinal juices of constipated persons have more power of digesting cellulose than normally. Whether this can be proved or not, and whether we can determine in what digestive secretion this power lays, I do not know. But at all events this supposition answers very completely many of the facts about constipation which puzzle us.

It explains why the most carefully formulated diet which is calculated to give the intestines more bulky foods to work upon, usually fails entirely to cure constipation. This is because the materials that we count upon to render the food bulky are those rich in cellulose; and since this cellulose is digested no effect is obtained. It explains why the stools of constipation contain very little cellulose, although a good amount of vegetables are ingested; and why the actual quantity of bacteria is less in such stools because cellulose is the main food of the intestinal flora. That the too perfect digestion of the cellulose is due to bacterial action is unlikely, because, as I have said, the number of bacteria is actually diminished in constipation.

Schmidt's whole investigation appears to discount the assumption that bad effects always follow chronic constipation. While

we cannot doubt that at times, some toxemia must result from serious fecal stagnation, especially when there is an element of fermentation added, still Schmidt's work indicates that we can very easily exaggerate the amount and danger of absorption of intestinal poisons. It certainly places the burden of proof upon these observers who are fond of claiming intestinal autointoxication arising in constipation as the cause of so many conditions. If I am not mistaken, the theory of autointoxication in constipation has very little foundation in experimental evidence. These facts also oppose the idea which has been more or less prevalent, that an increase in the urinary indican in constipation signifies an increase in bacterial action in the intestine. This was assumed apparently without any effort to investigate the contents of the bowel in order to explain the increase in indican in the urine in such cases. On the contrary, as I have pointed out, the activity of the intestinal flora is really diminished in constipation, and it is really the absorption of indican that is increased while its production is absolutely diminished.

From what has been said it will be seen that the treatment of this so-called atonic constipation, is to regulate the diet so that it will contain sufficient cellulose to furnish ballast for the intestinal contents and at the same time provide food for the intestinal bacteria. Thus, fibrous vegetables rich in cellulose should be given, such as cabbage, lettuce, and other salads, corn, string beans, foods containing hulls of grain, as oatmeal and the coarser cereals, oatmeal biscuit, whole wheat and bran bread. I have noticed in my work upon the stools, that mushrooms come through practically undigested, and they may prove a useful food for cases of constipation. Tomatoes usually furnish considerable undigested residue. The list of suitable foods is too long to be given here. Moreover, it varies considerably in different localities and with different persons. The important thing to be emphasized is that a considerable quantity of food containing an excess of cellulose must be added to the usual diet.

Whether Schmidt is right when he suggests that cellulose is digested more perfectly in the intestines of individuals who suffer from constipation than in normal persons, must be settled by further observation. This hypothesis, however, would explain why

it is so difficult to remedy the so-called atonic constipation by diet alone, and also why so few food remnants, even of vegetables, containing a large amount of cellulose are found in constipated stools. The best way to regulate the diet is to vary the food and to watch the stool in every case until we can determine what vegetables furnish the maximum of remnants in the stools, and diet our patients upon this basis.

As I have said, it seems probable that the inaction of the intestines in these cases is due primarily and in large part to a lack of necessary stimulation which is normally furnished by the products of bacterial action. Therefore, it seems permissible to add to the diet in such cases some substance that will furnish a mild artificial stimulant to the bowel wall. In accordance with this idea I have never found that harm was done by the careful use of cascara or rhubarb in small doses in cases in which digestion is normal, and there is no evidence of decided weakness of the bowel muscle. The use of these remedies produces a normal form of evacuation and apparently does little more than promote a spontaneous emptying of the bowel. Schmidt uses cascara in this manner, and I see no objection to giving it in connection with mechanical and dietetic treatment. The failure of such treatment to relieve constipation seems to be in the lack of spontaneous evacuations, more than in any lack of the small or upper part of the large intestine.

Since cellulose is digested to an undue extent in the intestine of a person subject to constipation, the rational treatment of the condition would be to find some food substance that is voluminous, rich in water, and in which the cellulose is in such a form that it will not be digested. Besides, this substance must be unirritating to the mucous membrane. Such materials are not easy to find. In his search Schmidt has even tried cork and similar materials, but without the desired results, since although these substances made the stools more voluminous they were not rich enough in water to keep the feces soft, which last condition is, of course, desirable. Schmidt has discovered at least one substance that fulfilled all the conditions. This is the preparation of Japanese seaweed, known as agar-agar, which is so well known in bacteriologic work. It swells easily in water and gives up the water again very slowly. It contains 0.6 per cent. of cellulose. It also resists bacterial action.

Schmidt found that if agar-agar was given by the mouth, it rapidly swelled in the mouth and stomach and was passed in the stool practically unchanged. The stools were soft, rich in water, and were passed more promptly than usual. The substance is not irritating even in large doses, except when given in a powdered form. It then produced pain and diarrhea, which was probably caused by the too rapid and excessive swelling while in the gastrointestinal tract.

In chronic constipation the ingestion of moderate amounts of agar-agar caused large soft stools. The significant fact is, that the dried weight is increased and increased much more than would be explained by the weight of the ingested agar, showing that the agar carries the fecal matter through the bowel with it. However, the passages were not passed spontaneously from the rectum. Schmidt suggests that the reason why the stools were not spontaneous is that the bowel still lacked the stimulus of the products of bacterial action since agar does not favor bacterial growth.<sup>4</sup> That is, agar remedies the excessive digestion of cellulose but does not furnish the needed stimulus to spontaneous evacuation.

In order to correct this lack of stimulation, Schmidt has added a small amount of extract of cascara to the preparation, not enough to act as a laxative but merely to furnish a little stimulation to the bowel wall. He used the agar as it comes in strips cut into convenient lengths. The substance works as well in spastic as in the atonic form of constipation. Schmidt has used agar-agar in twenty-five cases of constipation of various sorts, and in two-thirds of them the agar therapy gave very good results. The other one-third needed other forms of treatment besides; such as physical methods supply. One must not be disappointed if the method does not give very prompt results. It is after all a treatment by diet and not by drugs, and patience and perseverance are needed to obtain the result looked for.

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<sup>4</sup> It may strike one as peculiar that the statement is made that agar-agar does not favor bacterial action—although the substance is used for culture media. It must be remembered, however, that agar is merely used as a framework of the culture media; and, indeed, is so used because it is resistant. The pabulum for the culture is the meat extract, etc., that the agar culture tube contains.



Another substance that fulfills most of the conditions required for an intestinal ballast is liquid paraffine. It is liquid, passes unchanged, is unirritating, and can be rather more readily given than agar. Schmidt employs the liquid paraffine of the German Pharmacist. But he has also used the American liquid white or yellow vaseline, with equally good results. Paraffine acts much as does agar and needs the addition of a small amount of cascara to produce the best results.

**THE MECHANICAL TREATMENT OF ATONIC CONSTIPATION.**—As I have said, the etiology of constipation is too complex to warrant the hope that we can cure every case, or, indeed, any one case by correcting only one morbid condition. Even if atonic constipation is caused primarily by error in diet, as Schmidt's investigations very strongly indicate, it seems probable that weakness of the bowel wall plays an important part in most cases.

In some cases, it is conceivable, as Nothnagel has suggested, that intestinal innervation is at fault and we have to do with a true atony. Pure cases of this sort are probably rare. But cases of constipation from improper diet may well occur much more easily in cases in which the whole nervous system is below par than in normal individuals. Again, constipation from improper diet, especially if combined with carelessness of habit, will probably cause disturbance in the intestinal muscle *secondarily*, and this will need correction before we can hope to overcome the sluggishment of movement in the intestinal contents. The intestinal muscle can probably be influenced best by mechanical measures.

Here it is very essential to distinguish sharply between atonic and spastic constipation. What I have said in the last few pages applies to the so-called atonic form. Let us now consider the mechanical treatment of this variety, reserving the methods of treating spastic constipation for a further paragraph.

**Hydrotherapy.**—The treatment is very useful in influencing the bowel probably as much by improving the general tone of the system as by any action that it has upon the bowel wall. It has the advantage that it can be given so as to occupy only a part of the patient's day and allow him to go about his usual pursuits. Probably the best method of its administration is the so-called thermic contrasts. Heat is applied in the electric light cabinet, steam room,

or cabinet. Then cold is applied in the half bath or Sitz bath, varying the temperature from 80° F. to 70° F., depending upon the age and strength of the patient. This is combined with general cold douching. Or the Scottish abdominal douch can be given. This latter furnishes a very strong stimulation for the bowel.

*Massage* is often of the greatest use if properly given, and of no value if not applied as it should be. It must be given by an expert, and by the hand only, for the various forms of mechanical massage are not nearly as useful as that given by the hand of a skilled operator. The treatment must be systematic and prolonged until a satisfactory result is obtained. Massage promotes the thorough emptying of the bowel, helps the flow of intestinal secretion and probably influences favorably the nervous mechanism of the bowel wall.

*Gymnastics.*—There is no question that chronic constipation is influenced favorably by exercises that strengthen the abdominal wall. The so-called room exercises and resisted movements are often all that are required. In these the patient lies on the floor and raises himself to a sitting position by catching his toes under a piece of furniture and using his hip as a fulcrum, or raises his leg by flexing the hips and so on. Various systems have been formulated for this form of treatment. Sports are to be encouraged, such as riding, walking, rowing and golf.

*Electricity.*—Certain observers have found that the faradic current is often of benefit. The faradization may be abdominal entirely, or lumbo-abdominal or recto-abdominal.

*Balneology.*—The various water cure establishments, as a rule, are not calculated to help chronic constipation. This form of treatment is little different from the habitual use of laxatives, as almost all the waters used in such places are more or less powerful solutions of saline purgatives. However, it must be acknowledged that good results sometimes follow a "cure" at such resorts. In such cases it is probable that the improvement has come from the exercises and healthy regime required in such institutions and has occurred in spite of the waters and not because of them.

The danger of overstimulation must not be forgotten in this form of treatment. It may easily occur if any one of the treatments is given too frequently, especially when the patient is not in

an institution but is going about in his usual occupation. Overstimulation may be avoided by intermitting the different forms of mechanical treatment and by alternating one sort with another.

**SPASTIC CONSTIPATION.**—Considerable attention has been paid of late to that form of constipation which is supposed to be produced by spasm of the bowel, especially of the colon. I think there is no doubt that there is a form of chronic constipation that is associated with general nervous irritability, and is more or less of the spastic type. Whether it is so frequent and important as is claimed by some observers, I think may be open to question. The extreme type of the condition is, of course, the constipation of lead colic. The form of most interest to the clinician is the chronic milder variety. This usually occurs in women of a neurotic type, who frequently show spastic conditions in other parts of the body as well, such as cardiospasm, pharyngeal spasm and so on. The general nutrition is apt to be poor. The abdomen is usually not rigid but is flaccid and relaxed. The bowel itself is often tender and in extreme cases can be felt through the abdominal wall to be contracted in knots. The sphincter ani is very often firmly contracted. The physical character of the stools is often important in diagnosis. They are of small calibre, often as small as a lead pencil or little finger, and broken into pieces, sometimes large and sometimes small, giving the impression that the stool has passed through a spasmodically contracted intestine. The stools are very small in amount and the desire for defecation is often present without result. As the spasm passes the physical characteristics of the stool return to normal, and this variation in their form is an important point in the diagnosis.

**TREATMENT OF CHRONIC SPASTIC CONSTIPATION.**—The diet naturally must be unirritating, but at the same time must be directed toward improving nutrition. Fats are a most useful food, as they fulfill both of the above conditions, and one of the best forms in which they can be given is milk or cream.

*Hydrotherapeutic Measures.*—The physical treatment of spastic constipation is, of course, just the reverse of the treatment of the atonic form. All stimulating hydrotherapy must be avoided, especially the thermic contrasts. Very good results have been obtained from the cold, wet pack applied to the whole body for

one and a half hours. This is followed by sponging or spraying the body with tempered water with not too much pressure; all procedures that stimulate the bowel are, of course, to be avoided. For cases with much colic-like pains, warm compresses and other means of applying heat locally, are often of benefit. In general, however, local procedure should be avoided.

*Massage* of the abdomen and *faradisation* are, of course, contra-indicated. *General massage* and *gymnastics* suited to improving the general tone of the individual may be permitted, but all local stimulation must be forbidden. In some cases general exercise taken cautiously and under the control of the physician seems to do good, but its effect is often uncertain; and certainly all great exertion must be avoided. All athletic sports are to be forbidden. As a rule, the more rigidly the patient is kept at rest the better is the result. As has been said, probably the best remedy is prolonged wet packs, which often are successful in producing a normal stool.

I have found oil enemas very successful in my cases of mucous colic when the constipation is of this spastic type. The oil is given as high as possible into the colon through a large catheter, while the patient is on the back with the hips raised. Six to eight ounces can be given once every day or every other day; the oil should be allowed to remain in the bowel as long as it will stay. It seldom fails to produce one or more easy stools in the twenty-four hours. The patient must be warned not to try to go to stool whenever he fancies he has a desire, and the less his mind is allowed to dwell on this part of his body the better.

Tobias advises that an attempt be made to train the bowel by going to the closet once daily, always at the same hour, whether a result is obtained or not.

Various drugs have been recommended, such as bromides, belladonna, and opium and belladonna, by suppositories. Of course, all purges are to be avoided, as their use will always aggravate the spasm. The mineral water cures are to be avoided for the same reason. Dilatation of the sphincter and hypnotism has been tried with varying success.

# THE TREATMENT OF OBESITY<sup>1</sup>

A CLINICAL LECTURE

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GENTLEMEN: In the series of lectures previously delivered to you upon the subject of obesity I stated that the treatment thereof could not be a specific one, as the clinical forms are so diverse,—nor could the division, as taught by Oertel and others, into plethoric and hydremic polysarcia be justified from the practical or the scientific standpoint. I preferred to distinguish between an obesity caused by an excess of food conveyed to the organism, a deficiency in the consumption of organic material, or both of these together. I adopted this classification despite the fact that such researches as are available have not been found sufficient for practical purposes and must be accepted with great reserve. I also stated that it is not always easy in practice to classify obesity according to the “organic balance” of the fat person, because the calorimetric value of albuminoids, fats, and hydrocarbons to the normal adult, whether at rest or in muscular activity, differs from that to the obese subject, especially when compared to the body weight. I pointed out a practical method of calculating in calories the value of various articles of food and beverages, and emphasized the fact that the calorimetric value of ingested food and beverage is always inferior to that of absorbed food and beverage within various degrees. I called the attention of the physician who treats obesity to the necessity, (1) of removing such factors as impair metabolism, such as gout, scrofulosis, chlorosis, anemia, etc.; (2) of maintaining the metabolic balance between ingested food and excreted material; and

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<sup>1</sup> Reported and translated by Leon Lebovici, M.D. (Vienna), Carlsbad, Bohemia.

(3) of neutralizing any morbid effects from the existing obesity. As the first point would have carried me too far afield, I considered the question of changing the metabolic balance of the obese person, and stated that in general it is important to reduce the quantity of water taken during the meals to the minimum and to give between meals such amounts as would be required by the particular individual. From this point I shall commence the present lecture.

Practical experience has shown that all obese persons do not tolerate the dry diet to the same degree, and I have observed chronic gastric or intestinal disturbances, renal colic, gouty attacks, or pronounced neurasthenia to follow the persistent reduction of liquids by the medical adviser or the patient after distinct signs of intolerance were manifest. Highly colored urine with deposits of uric acid or urates, traces of albumin or sugar in the urine, renal or hepatic colic, diminished diaphoresis, or gastric disturbances are all indicative of intolerance to the dry diet. It is well to advise, as proposed by Schweninger, that four or five meals should be taken in the twenty-four hours and that liquids be given about two hours after each meal in amounts depending upon the degree of thirst and sufficient to dilute the urine, promote diaphoresis, and avoid constipation.

The rationale of the dry diet is not entirely clear nor are the reasons adduced by Oertel and Schweninger more than hypothetical. One fact has not been sufficiently emphasized, namely, that many obese subjects habitually drink too much water during the meals, and the withdrawal of the liquid proves a stimulus to the morbid increase of bodily fat, but the method of so doing has not been determined. Care must be exercised that the lessening of water is not carried out too suddenly nor the too rapid reduction of weight attempted, one kilogram a week being the most that may be attempted, and even that for periods of not over three weeks.

The albuminoid food must not be reduced to such an extent as to cause a nitrogen loss greater than that introduced into the body; otherwise great general weakness will be experienced by the patient. Frequent quantitative estimations of the excreted nitrogen should be made, in order to determine this point. In general, the maximum withdrawal of certain foods and consequently the loss in

weight must be attempted very slowly, in order to obtain a stable weight at the end of the cure. I do not prepare dietary schema, because the method of treatment must vary with each individual, be dependent upon his habits and gastric susceptibility, and be so adjusted that the patient is comfortable at all times and thoroughly satisfied with his condition.

Dietary regulation constitutes but a part of the treatment of obesity, there being a number of other measures by means of which the organic balance of fat persons is restored and the accumulated fat made to disappear.

*Physical exercise* should be prescribed (particularly for those patients having a tendency to muscular laziness), in the form of walking, fencing, cycling, horse-back riding, or gymnastic exercises, etc. Over-exertion must be carefully avoided and the amount of exercise especially regulated for those suffering from cardiac weakness or arteriosclerosis.

General and local massage, when skilfully given, is often productive of good results, especially when applied to areas such as the abdomen, where great accumulations of fat take place. \*

Hydrotherapy, especially those baths containing carbonic acid gas and those containing chlorides in various combinations are very beneficial when carried out with due consideration of the strength of the patient. Hot salt baths, sea bathing, steam baths, hot dry air baths, the so-called electric light baths, etc., are all useful, but must be avoided in patients with cardiac valvular insufficiency or arteriosclerosis.

Mineral waters are very useful, particularly those containing sulphates, chlorides, alkalies and—in anemic individuals—iron. Marienbad, Karlsbad, Montecatini, Kissingen, Vichy, etc., offer exceptional advantages in the cure of obesity not only from the use of the waters, but because there is combined a methodical, rational physical therapy, massage, medical gymnastics, electrotherapy, balneotherapy, etc., together with a carefully regulated diet. I have observed that patients who merely drank the waters at these resorts have returned not only unrelieved but have actually increased in weight from the stimulation of the appetite and thirst. I do not, however, wish to be understood as underrating the value of these mineral waters in regulating metabolism, since numerous

investigators, Seegen, Ziroty, Mering, Loewy, Dapper, Jacoby, Kirch, Winternitz, etc., have proved their value; but I wish merely to emphasize the importance of physical and dietary regulations, in addition to the drinking of the waters.

The number of hours passed in sleep must be moderate, since Pettenkofer and Voit have shown that sleep favors the accumulation of fat. The patient should live in an open, well-ventilated house, and, particularly in the hot season, at some elevation. Mental strain and worry must be avoided, occasional change of place and climate are beneficial, and the clothes should be so arranged as to favor free respiration and not to hinder diaphoresis.

The use of drugs in the treatment of obesity is ill-advised and may do great harm. Such medicinal agents as may be given should be administered only in response to certain symptoms or conditions occurring in the course of treatment. I therefore will not mention, even to condemn, the host of remedies which have been advised, such as venesection, vinegar, purgation, iodides, and, more lately, preparations of the thyroid gland, etc. I have noted many nervous disorders and cardiac disturbances from the use of thyroid extract, and, while its use may produce a cure in mild cases, the method of treatment herein described will attain the same result without endangering the health of the patient. Constipation, however, should be corrected by the use of mild purgatives, which also aid in the withdrawal of water from the body tissues. The iodides may occasionally be used for their alterative effect, and alkaline medicaments are often useful, but should never be pushed to the extent of causing what Trousseau calls "the alkaline cachexia." They are especially useful in lithemic and gouty individuals. Iron may be needed for anemia, strychnin and phosphorus for nervous depression, cardiac tonics, such as spartein, strophanthus or caffeine, for a weak systolic action.

It need hardly be emphasized that the liver, heart, blood vessels, and kidneys should be systematically examined and morbid conditions corrected, because not only do these of themselves produce trouble, but their correction greatly facilitates the success of treatment directed against the obesity itself.

The dietetic regimen must be guided by the type of obesity, the quantity of food being diminished in some cases or simply



altered in quality in others. We must take into account the altered metabolism of the patient whereby more fat is derived and retained from the food, and while regulating the quantitative excess of food, whether absolute or relative, must also remedy the absolute or relative deficiency in the consumption of fat. In general terms the quantitative reduction of food will depend to some extent upon the calorimetric value of the articles of food allowed.

One should also remember that the physical condition may vary with the increase of obesity, some patients appearing well nourished, with normal organs and a generally exaggerated look of good health, while others are influenced unfavorably from the beginning of the accumulation of fat. In deciding upon dietary regulations one should also remember the types into which obesity may be divided, distinguishing between the subjects who eat too much, thereby adding fat to the body and correcting morbid tissue changes, and those who eat less of badly chosen food which also supplies fat but does not suffice for the nutritional or functional exigencies of the various organs. In some patients the impairment of the organic balance results in great deficiency in nutrition and derangement of function, and yet the fat accumulates to such a remarkable degree as to constitute a huge lipoma.

In conclusion, let me add that a careful consideration and analysis of the patient's metabolism based on clinical and chemical data will enable us in every case to meet successfully the therapeutic indications. The earlier treatment is begun the more prompt and more satisfactory will be the results, because, as has been stated, the protracted cases are frequently accompanied by morbid states of nutrition. Obesity developing at puberty or earlier, or if the fat accumulation is acute and rapid, or if due to constitutional disorders, scrofulosis, syphilis, gout, chlorosis, etc., indicate energetic early treatment. The nitrogen, the phosphorus, the iron, etc., contained in food or drug must actively regulate the metabolic balance and produce a normal condition of nutrition and function in all the tissues and organs. The problem may be complex, but can be solved if the individual patient is studied scientifically.

## THE NON-OPERATIVE TREATMENT OF RENAL OR URETERAL CALCULI CAUSING COLIC

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WHILE there are many causes of renal colic, the assumption is that the attacks of pain are due to the presence of stone or gravel, until an exact differential diagnosis can be made showing that they are due to some other cause. Most of the other forms of renal colic, though well known, require great care for their recognition, and are often deceptively like attacks due to the presence of calculus.

The commonest of these other affections which produce pain in the kidney or characteristic renal colic are tuberculosis of the kidney, hemorrhagic nephritis, and certain types of nervous disease. In hemorrhagic nephritis the spasm of the ureter which causes the pain is due to the presence of a clot of blood which prevents the passage of urine. This may become so completely disintegrated that at operation in this class of cases nothing can be found to account for the bleeding and consequent colic, unless a microscopic examination of a section of a piece of kidney is made.

The diagnosis of renal colic is not difficult, as a rule. The principal symptoms are the presence of agonizing pain in the abdomen, often accompanied by nausea, yet without any fever, and usually without any rigidity. The pain shoots down to the genitals and along the inner part of the thigh. A symptom that is frequently, but not always, present in strangury. The patient has an intense, almost constant, desire to pass urine, but at most is only able to void a few drops at a time.

The most common cause of renal colic is the impaction of a stone in the ureter. This usually takes place just beyond the pelvis of the kidney at the commencement of the ureter, or at one of the narrowed portions of this canal, such as occurs just below the brim of the bony pelvis. In modern days the knowledge of appendicitis

has become so widespread that if the pain is on the right side the patient's first thought is that he is suffering from an attack of this dread disease. Even after the assurance that such is not the case, he is not much relieved, since the pain of renal colic is enough of itself to be very seriously disturbing.

The physician's first thought is likely to be that morphin is the best remedy to relieve the pain, and accordingly immediate recourse is usually had to the hypodermic needle. If the renal colic is very acute, however, and if the stone is thoroughly impacted and of such size that it does not readily pass through the ureter into the bladder the ordinary hypodermic injection of morphin will give very little relief. Even a second and a third injection will often disappoint the medical attendant by their utter inefficiency to relieve the pain. The spasm of the ureter in these cases causes such intense pain that only enormous doses of morphin will make the patient comfortable. In the meantime it must not be forgotten that there is a constant danger of having the morphin produce anuria, not only in the kidney that is suffering from the presence of the stone, but also in the other one, and this, of course, may prove a very serious complication.

The best method of relieving the spasm of the ureter, for this is the true source of the pain, and not the traumatism of the sharp edges of a rough stone, is to give chloroform by the mouth. About a teaspoonful of pure chloroform should be quickly swallowed and followed by a small draught of water. The chloroform will cause a disagreeable strangling sensation, but immediate relief from this is afforded by the draught of water. Properly speaking this not a large dose of chloroform and only a small portion of it is really absorbed. Most of it is vaporized by the heat of the body shortly after it reaches the stomach and is belched up in the form of gas. Enough of it is absorbed, however, to afford a good measure of relief for the pain of the renal colic, and no other remedy acts so rapidly or with such certainty and efficiency.

After the administration of the chloroform the patient should be put in a hot bath; while the hot bath is preparing, however, there is a manipulation which is often of the greatest service in relieving the pain. If there is any reason to believe that the stone is only engaged at the beginning of the ureter or at the exit of the pelvis

of the kidney it is well to invert the patient and to perform brisk bimanual massage over the affected kidney. The kidney region should be firmly kneaded with the two hands while the patient's hips are well above the level of the kidney; not infrequently immediate and complete relief will be afforded by the calculus dropping back into the renal pelvis. When this simple manipulation succeeds patients are always most grateful and the case is practically at an end for the time being.

If this inversion of the patient does not afford relief, he must be placed in a hot full bath. This affords the next best means to surgical anesthesia to secure complete relaxation of the tissues. It produces relaxation to such an extent that palpation of the abdominal organs becomes perfectly possible, even under quite unfavorable circumstances. This is, indeed, the best means to secure abdominal relaxation, since a general anesthesia always has an element of danger in it and therefore patients and their friends always have a certain amount of objection to it.

Frequently the patient must remain immersed in the bath for a half hour or more. Usually he experiences complete relief with no further pain symptoms as far as concerns this single attack, that is to say the stone drops back into the pelvis of the kidney and produces no further discomfort until it is again engaged in the ureter; or the spasm of the ureter ceases for the time, the stone remaining quiescent where it has become lodged. Often there is a strong desire to urinate while the patient is in the bath; the spasm of the ureter relaxes, and the distended pelvis of the kidney is allowed to empty itself. This affords great satisfaction to the patient. In severe colic due to a rough calculus the interesting phenomenon is sometimes witnessed of having a rather free passage of bloody urine though perhaps no hematuria was noted before. The reason, of course, is that with the relaxation of the ureteral spasm the urine that has been collecting has an opportunity to get past the stone.

After the relief of the acute pain and the passing away of the depression due to the attack there comes the interesting question of how to prevent a recurrence of renal colic. It is only proper to tell the patient very frankly if it be a first attack that there is still some doubt as to what the real cause of the colic may have been,

though it is reasonable to suppose that in most cases it is caused by the movements of a calculus in the renal passages. The question of operation should not be considered early in the case. There is scarcely any disease that can be managed and carried along so easily without operation as renal colic, if it be uncomplicated. When fever is present or when a septic condition is suspected then the advisability of operation must be considered at once. Many patients, however, will go on without further colic or be well able to attend to their affairs without serious inconvenience for many years and with only infrequent attacks of colic. Persons have lived comparatively comfortable lives with a large stone in one or both of the ureters, and the urine continues to pass by the obstruction, except when the stone becomes dislodged from the bed it has made for itself and seeks a new position. Frequent colic requires operation, and signs of sepsis, local or general, had best be considered as an indication for surgical intervention.

There is, however, a very simple method of non-operative treatment which has given remarkable success in a number of cases. In all of these the renal colic was due to the presence of calculus and the beneficial effects were obtained by simple water drinking. My own experience has been so fortunate that I would not think for a moment of advising an operation in any case of suspected renal calculus without giving this method a fair trial. It is useful, however, only in uncomplicated cases. I must again emphasize the fact that if fever is present the question of prompt operative intervention must be seriously considered.

The method consists in having the patient take large quantities of water within a short space of time, once or twice a day. My rule is to advise the patient to drink about two quarts of distilled water at a sitting in as short a time as it can be swallowed without producing discomfort. The water should neither be cold nor hot, but at room temperature. The time required to take two quarts of water varies with different individuals, but most persons can take it within an hour. The reason for having the water taken in large draughts is to cause a sudden flushing of the urinary tract. The water is absorbed rapidly from the stomach and nearly as rapidly excreted by the kidney and the consequence is a swifter current of urine than usual, which tends to carry the

stone before it. This is the mechanical factor in the treatment that does good. There is besides a physico-chemical factor since distilled water acts as a solvent.

Many of the kidney stones are slowly soluble in water and their rough edges become smooth by their gradual solution. I am also of the opinion that there is often even a considerable loss of bulk in a relatively short time.

In order to make sure that when the stone is passed it shall not escape notice I recommend that male patients shall carry little squares of cheese cloth with them through which urination is performed. In this way the stone is caught. If the patient finds it his mind is greatly relieved, but the necessity for further continuance of this method of treatment is not necessarily at an end. Of course, the little squares of cheese cloth are to be thrown away immediately after urination. Women are recommended to use a vessel and carefully examine each specimen of urine passed.

Unless the colic occurs frequently patients will usually not get tired of this method of treatment. It may be necessary in some cases to continue it for six months, though in my own experience less time than this has usually been sufficient. When the colic is frequent, then the discomfort of the patient will demand more incisive measures, and recourse must be had to surgery before the patient's general health has been seriously disturbed by the attacks of pain, the anxiety, and the consequent depression of spirits.

If there is no bleeding in connection with the attacks of colic, but only the passage of turbid urine, then small doses of hexamethylenamine should be given after the hot bath has relieved the pain. Personally I consider that five grains (0.3 gram) twice a day is quite sufficient for the purpose. This will produce diuresis and will clear up the urine. If hematuria occurs, salol, five grains (0.3 gram) three times a day should be substituted. Hexamethylenamine is unsuitable in cases of hematuria, because in the course of its elimination it liberates formaldehyde and this is distinctly irritating to bleeding surfaces.

This method of treatment needs only a fair trial to prove its worth to any one who is ready to receive the evidence. In order

to make it clear how useful it has been in my own experience I shall illustrate it by some typical cases:

CASE I.—My first case was that of one of my friends, a man about 32 years of age. It was in the days of my early medical practice, and I was summoned to the patient's home to find that he had been taken with severe renal colic, the sudden pain of which had sent him to bed in great agony. The symptoms were characteristic and included nausea and vomiting. He had severe strangury and strained constantly to pass urine, though only a few drops came at a time. He was given a warm bath, which afforded almost immediate relief and was followed by the flow of a considerable quantity of bloody urine.

After the attack was over the only instructions given him were to stop the use of alcohol entirely, even his customary glass of wine with dinner being forbidden him. He was recommended to take large draughts of water frequently during the day so as to consume at least four quarts in every twenty-four hours. No other method of treatment was recommended. Examination of his urine a few days after the attack of colic showed that there were occasional red blood cells present (these are an almost invariable accompaniment of stone); besides these there were a few hyaline and hyalo-granular casts and a faint trace of albumin.

About three months after this first and only attack of colic the patient, having faithfully kept up the water treatment in the meantime, passed a calculus which he felt distinctly coming through his urethra and which he heard drop into the bowl of the closet. It was not recovered, however. His urine in the meantime had almost entirely cleared up and after the passage of the stone there were no further pathologic manifestations in it. Careful urinary examination made one year later for the purpose of taking out a policy of life insurance showed absolutely normal urine. It is now fifteen years since the original attack of colic and the patient has never had another nor any symptom or difficulty of any kind in the urinary tract.

CASE II.—Another very typical case was that of a man, of 72 years, who after having been previously healthy had his first attack of renal colic. Though the pains were characteristic, he was very much alarmed because he believed that he was a sufferer from

appendicitis. There seemed to be good reason to think that the stone in this case had been previously in the pelvis of the kidney and that it had only become engaged in the upper end of the ureter. The case seemed favorable, therefore, for the practice of the inversion treatment. He was placed with his hips elevated at an angle of forty-five degrees over a chair and vigorous kidney massage was performed. He was relieved of all pain after a few minutes of massage. Indeed, the effect of this treatment was almost magical in its promptness and completeness. Very little after-treatment was needed to make him feel entirely himself though he had been very much worried by the thought of appendicitis and depressed by the severity of the pain.

In this case there was no blood in the urine at any time, and under the small doses of hexamethylamine the urine cleared up satisfactorily. He was put upon the water treatment and four months later sent me a letter expressing his lively sense of gratitude and enclosing a sketch of the stone which had been passed. It was about  $\frac{1}{4}$  inch in diameter and had evidently been somewhat rounded by the solvent action of the water. In the meantime he had had several attacks of colic. Each of them had been relieved by inversion and by massage practiced by himself, for he had learned to appreciate the value of the manipulation and could perform it without much difficulty.

CASE III.—A third case is very instructive because it serves to show that the water treatment may succeed even when surgery has failed. Besides it illustrates that this method of treatment is applicable to the very young, as well as to those who are older. The patient was a boy, 12 years of age, who was admitted to Mount Sinai Hospital with a distinctly febrile condition and whose affection was diagnosed as a perinephric abscess. This was considered to be due to the presence of a stone in the kidney. Careful examinations with the x-rays failed to show any trace of the stone however. This is not so surprising if we remember that with the exception of cystine stones only those which contain lime in considerable quantities are revealed by the x-rays. These are the phosphatic calculi and those composed of calcium oxalate. Pure uric acid stones unless they are of large size are practically transparent to the x-rays.



In order to evacuate the pus the perinephric abscess was incised and thorough drainage established. Several days later the opening began to discharge urine and this condition continued for some weeks. A diagnosis was made of the probable presence of a stone in the ureter preventing the passage of urine in the usual way. An operation was planned in spite of the negative evidence of the x-ray examinations. The ureter was incised through the loin and a soft instrument passed down toward the bladder. It was arrested about one and one-half inches from the vesical end of the ureter. Methylene blue was injected into the ureter but made its appearance only tardily in the bladder. The stone could not be dislodged by any gentle means, so it was allowed to remain in place.

The wound was left open, but healed up in a few weeks after the second operation. After the healing had taken place the patient experienced occasional sudden rises of temperature up to 105° F., with pain in the right renal region. These gradually decreased in severity, however, and almost disappeared. When he left the hospital he was advised to take the water treatment, and within a month he passed a soft calculus about the size of a small pea. His urine, which contained blood and pus before this, cleared up in a few days, and has remained normal ever since. He has had no further attacks of colic and no further disturbance of his temperature.

These cases are, I think, quite sufficient to demonstrate that the water treatment if faithfully pursued will bring radical relief in many cases of stone in the ureter or in the kidney pelvis. Certainly in uncomplicated cases it would be rash to undertake any serious surgical intervention without giving this method a fair trial. It can do no possible harm and it may prove absolutely curative of one of the most serious and painful conditions to which a human being can be subjected. Undoubtedly the cures said to have been effected by many of the much advertised waters that are warranted to bring about solution of kidney calculi are really due to the water alone and not to any specific action of the dissolved ingredients.

# Medicine

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## CLINICAL OBSERVATIONS ON THE CARE OF TUBERCULOUS SUBJECTS

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MY first thought in this condensed report relates to the importance of a thorough examination of every patient who presents chest symptoms. This may be deemed by some to be unnecessary in these days when physical diagnosis is so well taught and its importance insisted upon, but from a somewhat large experience with physicians of more than average worth I know that I am right in saying that this is a duty often neglected. Tuberculosis is curable, but in the largest sense only in the early stages, and it is in the early stages, because of the mildness of the symptoms, that patients are given a slight examination, if any, and the golden opportunity is lost. Pedantic as this may seem, I unhesitatingly make this the first and most important topic. The recognition of the subcrepitant rale, the prolonged respiratory murmur, the echo or the localized bronchial roughening, may give the physician six most important months' advantage in the care of the patient.

EARLY SIGNS OF PULMONARY TUBERCULOSIS are more important by far than the evidence of coarse lesions and advanced stages. The finding of the bacillus, while confirmatory, is by no means an early proof, and if possible we must anticipate the conditions which cause its expulsion. The Committee on Early Diagnosis of the National Association lays great stress on symptoms and signs indicating a tuberculous infection during the closed stage, that is, before caseation and breaking down of the tubercles and the appearance of tubercle bacilli in the sputum. Early typical, repeated,

though possibly slight hemorrhage, increased afternoon temperature, and a hacking cough are suggestive but not positive proof.

More important are the physical signs. Among these are a retardation in the movements over the affected portion of the lung, and a diminution of the excursion of the diaphragm of the infected side—shown by Litten's shadow. The use of the blue pencil to mark the border line of dulness and points of symmetry is strongly urged. The very earliest auscultatory sound is a rough and slightly diminished respiratory murmur, not to be confounded with the sharp puerile murmur of increased function. The respiratory sound loses its smooth quality and becomes impure and roughened (Sahli). This change is produced by slight inflammatory changes in the bronchioles, the air passing over an uneven surface and through a slightly narrowed tube. It precedes the crepitant rale and all other physical signs.

Of tuberculin, the x-rays, and the use of iodine salts to increase catarrhal symptoms, the Committee says their value has not been demonstrated, and a case will rarely be found in which they would add considerably to the information gained through other sources.

"Bronchial echo" is an early sign first noted by Dr. Amyx, of St. Louis, who gives me the following description: "'Bronchial echo' is elicited by having the patient utter the words 99, after taking a deep inspiration. At the end of the sound 99 there will be a high pitched bronchial air-sound, similar to the bronchial sound during expiration, as in instances in which there is an induration in any part of the lung tissue. This sign can only be heard during expiration, and depends upon the lung being well inflated before the patient utters 99. This insures that there will be air passing from the lung after the patient has repeated 99. It is during the period following the ending of the sound 99 that the bronchial echo is heard. It may be heard immediately after the sound of the word, or it may become more distinct toward the end of the expiratory sound which follows after saying 99. The bronchial character of the sound is much higher pitched than that which is heard during expiration without the addition of the voice sound. When 99 is uttered the tongue presses against the teeth. During this moment the air passing out of the lung is stopped—which causes a sudden backing up of the air in the lung.

When the word has been finished the air rushes out of the lung, giving a higher pitch to the sound produced thereby, owing to the great rapidity of the air escaping from the lung. The value of this sign lies in the fact that it can be heard very early in any beginning consolidation of the lung. In the presence of cavity formation its value diminishes, since such condition can be elicited by other signs."

My attention has been recently called to unilateral mydriasis as an early sign of pulmonary tuberculosis by Drs. W. W. Graves and John Green, Jr., in the wards of the Mount St. Rose Sanatorium. Just how much importance can be attached to it is uncertain, but that it is a most interesting phenomenon must be granted. Dr. Green sends me the following notes:

"The paper which directed my attention to the subject is by Bichelonne, 'De la mydriase unilaterale dans la tuberculose pulmonaire au début.'<sup>1</sup> The patient was a man of twenty years, who presented mydriasis on the right side. This was of the spasmodic type and accompanied by a slight widening of the palpebral aperture. The only definite pathologic abnormality found in the patient was a patch of induration at the apex of the right lung. Bichelonne considers that the mydriasis was due to direct irritation of the sympathetic nerves by the lung disease or by the affected glands in the neighborhood.

I find the following references to the literature in the paper:

Roque<sup>2</sup> notes pupillary inequality in unilateral affections of various portions of the body, especially in acute or chronic pulmonary affections and conditions accompanied by swelling of the bronchial and cervical glands. Rampoldi<sup>3</sup> published two cases in which a right sided mydriasis was supposed to be dependent upon sympathetic irritation incident to an apical pulmonary tuberculosis of the corresponding side. Comini<sup>4</sup> and Padova<sup>5</sup> cite similar cases. In Rampoldi's opinion the pupillary dilatation is due to a reflex

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<sup>1</sup> *Annales d'Oculistique*, October, 1905.

<sup>2</sup> *Archives de Physiologie*, 1871-1872.

<sup>3</sup> *Annali di Ottalmol.*, 1885, xiv, fasc. 4; 1886, xv, fasc. 2-3; *Revue d'Ophthalmologie*, 1887.

<sup>4</sup> *Annali di Ottalmol.*, 1888, xvii, fasc. 1.

<sup>5</sup> Morgagni, 1889, xxx.

irritation passing by way of the vagus to the cervical sympathetic, in line with the physiologic experiments of Oehl.<sup>6</sup> It may conceivably also be due to direct irritation of the sympathetic, which is in direct relation with the apex of the lungs, especially the right.

Destrée,<sup>7</sup> under the title "A premonitory sign of pulmonary tuberculosis," claimed that unequal pupils exist in 97 per cent. of all cases of pulmonary tuberculosis, and that the dilatation is dependent on the irritation of the sympathetic at the pulmonary hilus, incident to tuberculous bronchial glands. In another publication he affirms that this inequality is present in almost every case, although it may be absent for a variable length of time, not constantly present.<sup>8</sup> Deherain<sup>9</sup> encountered 26 instances of inequality of the pupils in 120 cases of pulmonary tuberculosis, the patients being under observation a month.

Pernot,<sup>10</sup> dividing the lung disease into three stages, gives the following: First stage, 324 cases, of which 19 had mydriasis on the affected or more affected side; second stage, 352 cases, of these 27 had unequal pupils, most of them having mydriasis on the affected side; and third stage, 464 cases, of which 66 had unequal pupils, generally a contraction (due to the destruction of the irido-dilator fibers of the sympathetic).

Bichelonne found 10 instances of mydriasis on the affected side in 69 cases of lung tuberculosis.

J. Kingston Fowler and Rickman J. Godlee<sup>11</sup> also refer to the condition.

The reviewer of Bichelonne's paper<sup>12</sup> has this to say: "It seems probable that unequal pupils may occasionally be found in cases of lung tuberculosis, if carefully and systematically looked for. If present in the earlier stages, as stated by some Continental writers, the symptom may be of value as an aid to diagnosis, and

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<sup>6</sup> *Giornale della R. Acad. di Medic. di Torino*, 1885.

<sup>7</sup> *Atti XI Intern. Cong. Med.*, Roma, 1894 (March, April).

<sup>8</sup> *Jour. de Médecine de Bruxelles*, 1904, xvi.

<sup>9</sup> *Presse Médicale*, Oct. 1, 1904, p. 630.

<sup>10</sup> *Thèse de Paris*, 1905.

<sup>11</sup> *Diseases of the Lungs*, p. 682.

<sup>12</sup> *The Ophthalmic Review*, July, 1906.

the point appears to deserve the attention of those who see large numbers of patients with lung disease."

Years ago Sir Andrew Clark, in the wards of the London Hospital, pointed out that sometimes the hectic flush is unilateral, and when so is always on the side of the affected lung. I have recognized this many times in hospital and private practice, and believe that this too may be the result of irritation of the sympathetic by a localized infection.

Asymmetry is always suggestive. Often we gain knowledge of local lesions in the lung only by comparison of source, movement, contour, and color—mention being, as seems to me, in the order of importance. Without discussing these at length let me note the value of direct antero-posterior mensuration of the lung capacity and movement. Often the asymmetry is so little that it cannot be detected by the eye or the ordinary tape (of little value at any time). Comparison of diameter and movement may be accurately made by large calipers placed at corresponding points. Elsewhere I have stated that an exceedingly small difference thus detected in the antero-posterior movement at any stage of the respiratory cycle is of value and should not be overlooked.

The value of the bacillus as an aid in diagnosis or prognosis is often overestimated. The recognition of "closed cases" in which as yet the bacilli are not thrown off, has not lessened the importance of the bacillus when found, but it has emphasized the fact that in certain cases of tuberculosis it is not found. Again, the number of bacilli is not indicative of the stage or rapidity of progress. At Mount St. Rose we divide our cases into three classes, according to the evidence from physical examination. The three clinical stages are those usually given in the books. The divisions from the microscopic showing are these: One bacillus in a field, or only one in several fields, is written down in first class; several in a field, as second class; an average of six, places the case in the third class; from six to ten in the fourth; and a large number or "clump" of bacilli, places it in the class five or five plus. Now it often happens that patients in the first or early stage clinically, are in class five or even in five plus from the bacteriologic tests. Conversely, though this is more rare, advanced cases may show few bacilli.

CHANNELS OF INVASION RELATIVE TO SYMPTOMS AND DIAGNOSIS.—The routes of invasion are worthy of continued investigation. At present the respiratory tract is by many considered the main channel, but with a larger opportunity for investigation than formerly, I am convinced that many more pulmonary cases are directly infected through the lymphatic and blood channels than are recognized by the average physician. The phenomena of invasion by the bronchial route have been studied not only clinically but in their pathologic sequence, and to such an extent has this study served that it has, until recently, overshadowed the other scarcely less important questions of infection along the lymph channels, or around the arterioles and capillaries by the blood current.

Without dwelling on the bronchogenic development along the respiratory tract which, to some extent, we have all followed, I would emphasize the value of infection through the lymph channels as a factor in the etiology of tuberculosis. Here again we find three methods by which the bacilli find their way into the lymphatics: First, it is asserted by Behring, who quotes Roemer, that albuminous bodies may pass through the walls of the alimentary canal and into the blood and lymph unchanged in new born animals, but not in adults. Behring fed anthrax bacilli to young guinea-pigs, and the bacilli passed through the alimentary tract without doing harm, while eight day old guinea-pigs similarly treated died quickly. Attenuated bacilli fed to young pigs were found in the blood. Ribbert believes that most cases of pulmonary tuberculosis are hematogenous, and that the bacilli pass through the pulmonary tissue into the lymph channels and to the bronchial lymph glands. From this point they are carried by the blood stream to the lungs, usually to an apex, because of comparative local anemia and a retarded lymph flow, due to hindered movement from ossification of the first rib.

A most important recent contribution to the study of lymphatic infection is a paper by George B. Wood.<sup>14</sup> After recording the results of his most interesting experiments made in the labora-

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<sup>14</sup>Section on Laryngology, Fifty-fifth Annual Session of the American Medical Association.

tory of the Pennsylvania Live Stock Sanitary Board and citing many authorities, he concludes: "The tonsillar tissue of the throat, because of its peculiar anatomic construction and of its topographic relations, is more liable to become infected by tuberculosis than any other part of the upper respiratory tract. In nearly all cases of advanced pulmonary phthisis the faucial tonsils become inoculated. In about 5 per cent. of hypertrophied pharyngeal tonsils some form of primary tuberculosis will be found. Primary infection of the faucial tonsil is a rarer condition."

Tuberculous adenitis in the cervical lymphatics develops in the majority of cases from infection originating sometimes in the faucial tonsils, but more frequently in the pharyngeal tonsil. The tubercle bacillus is probably unable to pass through the tonsil without having first overcome the vital resistance of the tonsillar tissue. The danger of systemic or pulmonic infection resulting from a tuberculous lesion in the tonsillar tissues of the throat is about equal to that of tuberculosis of the cervical lymphatics. The lesion to be expected as a resultant infection from the broken down glands of the neck is a miliary tuberculosis of the lungs. Further than this possibility, tuberculosis of the lymph glands of the neck is more dangerous than a localized tuberculous lesion in any other portion of the body.

As illustrating this proposition, I may briefly cite a case in the observation ward at Mount St. Rose: A woman, aged 40 years, had, for many months prior to admission, tuberculous infiltration of the cervical glands of the right side. Bacilli were found in the broken down structures, but consultation with several surgeons determined non-interference, because of the extent and the tissues involved. At first there was neither physical nor microscopic evidence of tuberculous involvement of the lung, though we made repeated and frequent examinations. Recently well-marked signs have appeared in the apex, but the infected lung is evidently as yet in the "closed stage." No bacilli were found in the sputum, though I have little doubt that they will be found.

The tonsils are more resistant to the action of bacterial toxins than ordinary lymphoid tissue. The latter proposition is also well set forth by Jonathan Wright, and its soundness will be more



readily admitted after reading Theobald Smith's essay, "Some Problems in the Life History of Pathogenic Organisms."

**IMPORTANCE OF POSTERIOR LESIONS.**—Diminution of the percussion note, with harsh breathing, and crepitation heard in the upper interscapular region, is suggestive of lymphatic infection and infiltration of the bronchial glands. The cases we have noted of this class run a much more rapid course than those in which the infection has been through the respiratory tract. It is true that the premise is hard to prove, but the fact remains that the cases most difficult to control have been those in which the physical evidence was most marked in the upper dorsal region. I would again urge that no chest examination is complete without most careful investigation of this region.

**GENERAL SYMPTOMS NOT INDICATIVE OF EXTENT OF LOCAL LESION.**—The progress and extent of the local lesions do not go *pari passu* with the general condition in pulmonary tuberculosis. This may be truthfully said of many diseases, but it is emphatically true I believe of pulmonary tuberculosis. We find it so in lobar pneumonia, which is also a specific disease. It is true, likewise, in many conditions of pus poisoning and local infection. It is, therefore, no new proposition, but one that has not been given its full value in formulating our diagnosis and prognosis in this disease. An advanced pathologic stage is not incompatible with fairly good general conditions. Such cases, in spite of extensive tissue disintegration, may become chronic, the advance may be checked, and the patient may live out his expectancy.

**HEMORRHAGE IS NOT ALWAYS HARMFUL.**—While it is true that hemoptysis is, in most cases, an indication of tuberculosis, yet the bleeding itself is sometimes palliative, at least for a while. When there is a local congestion, as when the bacilli have invaded the walls of small vessels by way of the perivascular lymph channels, or when there has been inflammatory reaction incited by the tuberculous process, a resultant hemorrhage is not an unmitigated evil. Obstruction in the lung to the blood flow may induce dilation of the right ventricle, and as a remote consequence, congestion of the liver, kidneys and extremities (Nothnagel). The local blood-letting may, for a time at least, permit equalization of blood pressure in these parts, as well as in the lung generally. We have

had cases in which there was a marked improvement of the vesicular murmur and a better percussion note within a week after a small pulmonary bleeding. Certainly these cases are exceptions, and too often the hemoptysis is recurrent and followed by vital depression and increase of the physical symptoms, but that the number of these cases warrants some attention, I firmly believe.

**MECHANICAL TREATMENT OF HEMORRHAGE.**—Our experience at Mount St. Rose warrants agnosticism as to the value of medication in hemoptysis. The only remedy that seems to have been of the least use is opium, and that only as a tranquillizer, not needed if physical and psychical rest can be obtained without it. Its best effect is to lessen the hacking cough so often persistent. Without discussing the various procedures recommended, I would say that we have found the restriction of movement of the affected lobe the best method for the relief of hemoptysis. A good sized towel is rolled—not folded—till it resembles a wide roller bandage. It is placed over the site of hemorrhage or as near it as can be estimated, either by previous knowledge of the case or by auscultation and palpation—never by percussion under such conditions. The roll is placed in position at right angles to the ribs and half way from the sternum to the outer boundary of the thorax. A wide bandage is passed around the chest and pressure made on the roll till the thoracic movement of the side is limited. The bandage is then fixed with safety pins, the patient placed in an easy recumbent position, with head and shoulders slightly raised, and an opiate given if there is much restlessness and anxiety. The bandage is adjusted from time to time and kept on for at least a fortnight. A thoracic tourniquet or truss as devised for use in our wards simplifies the application of the method. Compression as made by a pad on an adjustable screw attached to a band connecting a larger pad placed over the posterior chest.

**CONTROL OF NIGHT SWEATS BY TIMELY STIMULATION.**—The etiology of night sweats in tuberculosis is an unsettled question. It seems reasonable to consider them an evidence of exhaustion, following fever as they often do, and being immediately consequent upon the pulse decline during a sound sleep. This belief and the regularity of the recurrence has led us to adopt a simple and sometimes effective treatment. The time of the beginning of the

sweating is recorded as nearly as may be. Afterward the night attendant wakes the patient just before this time and gives an ounce of whiskey. Other stimulants have been tried, but the whiskey seems best adapted. With private patients an alarm clock is sometimes used. Good ventilation, light covering, the whiskey as suggested, and hydrotherapy, especially the spinal douche, are helpful.

**CONTROL OF FEVER.**—As the fever in tuberculosis is conceded to result from absorption of the toxins of tubercle and other bacilli, its treatment is too often futile. Rest is a necessity. A degree of fever in our cases means "bed," at least during the rise. More than that means absolute rest. Sometimes patients whose temperature is normal in the morning may be up for a few hours preceding the fever. The room must be well ventilated. Often they lie on cots on the veranda, but the idea of complete rest—mental as well as physical, if possible—is maintained. The value of the enema has been spoken of. Remembering the advocacy by good authorities of guaiacol externally in typhoid fever, we have used it in a number of cases of tuberculous fever, but the results have not been definite enough to warrant its endorsement. Cool sponging is always grateful. If the temperature is high a basin of water is placed by the bedside for the frequent wetting of a towel which the patient keeps on his forehead, or if need be on his chest. It is still better if an attendant use a sponge, allowing the water to evaporate and then applying more.

**CONTROL OF COUGH.**—There is no symptom that is more aggressive and oftentimes more yielding than the cough in chronic tuberculosis. Our patients are taught how to cough, or rather how to expel the sputum with little coughing. A deep breath is slowly taken, and then a quick strong expiration, or "exhaust" as one of the men—an engineer—calls it. In some of our wards there is very little coughing. When the pharyngeal and laryngeal irritation is great, relief is often obtained by inhaling a few drops of some anodyne mixture, such as equal parts of chloroform, alcohol, and ether, with a little creasote. This is inhaled from an ordinary drinking glass, or better still, from a glass tube in the center of which is a little cotton or a small roll of blotting paper. The tube is kept corked when not in use. Sipping hot water is sometimes efficient.

**AUTOINFECTION; USE OF NORMAL SALT ENEMAS.**—This topic deserves more extended notice. I believe it to be one of the most important chapters in the study of the symptoms and care of tuberculosis. Let me briefly call to mind that constipation (with intercurrent diarrhea) is found in most cases of pulmonary tuberculosis. It has been shown that bacilli in the sputum may safely pass the impaired gastric secretions, travel the course of the small intestine, and be found in the fecal accumulations in the colon and rectum; or they may pass into the deeper structures or the lymph channels or blood channels through an uninjured mucosa. The conclusion seems warranted that reabsorption of bacilli, with the products of metabolism and decay from the intestinal tract, is a potent addition to the primary infection. That this is more than a hypothesis can, I believe, be demonstrated. There is here a therapeutic suggestion which we try to make practical. In appropriate cases a high enema containing a small quantity of glycerin is given daily for a week. By that time the lower bowel is probably emptied of all scybalous masses. After that, the normal salt solution is used in quantities which can be retained. The exact form of treatment may vary, but the principle is kept in mind. The reduction of temperature and, in many cases, the improvement in assimilation following this part of the treatment, certainly suggest cause and effect. The premises may be wrong, but the conclusion is encouraging. The fact that other bacteria are factors in temperature-increase in tuberculosis does not alter the deduction as to the value of the method.

**WANING IMPORTANCE OF CREASOTE.**—Following the adoption of the suggestion last mentioned we have been willing to lessen greatly the amount of creasote and its substitutes. In fact, except with the idea of improving digestion and nutrition (and I confess my want of faith in this) the use of this class of remedies is almost forgotten in our treatment at Mount St. Rose, where we have had over 800 cases of tuberculosis in 3½ years. Certainly large doses of creasote, guaiacol, and their carbonates are not given. Here, again, I may be at variance with many of our best observers, but I predict that in another decade, very little, if any of this class of remedies will be used internally in the treatment of tuberculous cases.

**WANING VALUE OF CLIMATIC CHANGE.**—This is a topic which may only be mentioned here. The fact that tuberculous patients may recover in any climate, the injustice of sending the sick of any class away from the comforts of home and beyond the reach of friends to some mountain or plain where consumptives aggregate and herd, the uncertainty of selection even when change is proved best, these and many more considerations have wrought a marked reversal of practice with the thoughtful leaders in this department. The influence of Trudeau, Flick, and Knopf is becoming more potent every day in correcting this well-meant but mistaken action of the family physician.

**VALUE OF ALTERNATIVE EXPECTORANTS IN THE FIRST AND SECOND STAGES.**—Many authorities condemn expectorants altogether in pulmonary tuberculosis. I am not sure that this is right. In many cases there is a chronic bronchopneumonia in which the tuberculous infection is secondary and partial. In other cases there is a larger amount of inflammation than depends upon the irritation of the bacilli. When there are solidification and evidences of bronchitis without much crepitation and expectoration I know that good has followed the giving an alternative expectorant.

**HEART TONICS IN THE EARLY STAGES WITH INCREASED LUNG EXPANSION TO ENCOURAGE PULMONARY CIRCULATION.**—It has been fully demonstrated that heart weakness is a large part of the clinical picture in tuberculosis. In a majority of fatal cases the heart has been found abnormally small and nearly always flabby. Whether this is a result, or, as Brehmer interprets, a forerunner, of pulmonary tuberculosis, it demands attention, early attention. Diminished blood pressure in the lung favors tuberculous processes. The heart muscle partakes largely of the strength or weakness of the general muscular system. The inference is obvious. In all our cases the condition of the heart is a matter of inquiry from the beginning. Advantage is taken of everything that will tend to relieve lung stasis and strengthen heart action. Rest is ordered when indicated, with exercise carefully guarded, deep breathing, arsenic and strychnin, and in some cases when there is arterial dilatation, digitalis in small doses. I believe our best builder, so far, is the sodium cacodylate in daily hypodermic doses of a grain or more.

THE VALUE OF THE SPINAL DOUCHE.—No other simple measure seems to give the quick result that this does. In cases in which there is poor circulation in the extremities, morning languor, and chilliness, the direction is as follows: The patient early in the morning stands in the bath tub with the faucet turned to throw water of about 100° F. A large sponge is held under the faucet and is then pressed against the cervical spine. Repeating this several times, the cold water is turned on and applied as the other. After very slight rubbing with a towel the patient partly dresses and lies down for half an hour. This seems better than the ordinary cold bath, or the shower.

There are many other questions in the study of the care of these cases which cannot be discussed in this paper. The importance of frankness with the patient, the necessity of estimating and using the psychic condition in each case, the methods for guarding others, the hardship of needless exile, clothing, food, the value of regular stimulation in some cases, are all important in the great battle that is to give us a final conquest over this dread, but limitable and curable disease.

# **PULMONARY TUBERCULOSIS IN THE MIDDLE-AGED AND THE AGED**

**A PAPER READ BEFORE THE EALING BRANCH OF THE BRITISH MEDICAL ASSOCIATION**

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GENTLEMEN: At the time when I was honored by the invitation to read a paper before this Branch, I was giving some lectures upon Pulmonary Tuberculosis in Childhood, and it occurred to me that it might be interesting if I were to consider with you the subject of pulmonary tuberculosis as it shows itself in those who have reached the other extreme in life. Pulmonary tuberculosis in older people is, moreover, not unimportant, in view of the fact that it so often remains unrecognized and thus constitutes a danger to the community. In a paper which I read before the Harveian Society fourteen years ago, I pointed out that many of the "chronic bronchitics" and "asthmatics," who form so large a proportion of the older out-patients at any hospital, are spitting up tubercle bacilli and thus disseminating disease. That there is still reason to emphasize the comparative frequency of tuberculosis in persons well advanced in age may be inferred from a statement in a recent number of one of the chief medical journals, to the effect that there is a widespread idea that patients over 45 or 50 years of age are very rarely tuberculous. This idea is, as I have said, inaccurate, and probably arises from the fact that pulmonary tuberculosis in those who have passed the meridian of life may easily escape recognition. The conditions with which it may be associated modify the course of the tuberculous process, so that the symptoms are obscured and the signs of its presence in the lung are somewhat indistinct. Tuberculosis, when it attacks lungs already damaged by the degeneration of age, may add but little to the discomforts of

the individual who is already short of breath and "wheezy." The increasing infirmity of the patient is accepted as a sign that he is ageing more rapidly, and no suspicion of any added mischief is aroused or entertained. Yet the emphysematous or chronic bronchitic individual who has become tuberculous may be expectorating phlegm loaded with virulent bacilli, and be all unwittingly a source of danger to others. The solidification of tubercle may easily escape detection in a lung already practically solidified by fibrous degeneration; even if some increase in symptoms suggests a complication or addition to the chronic malady, physical examination of the lung may fail to explain the nature of the new development if the examiner is unmindful of the comparative frequency of this special complication. I have often found, both by physical examination and by the microscopic examination of the sputum, unmistakable evidence of tuberculosis of the lung in cases which were supposed to be simply chronic bronchitis or emphysema, as well as in cases of pulmonary fibrosis.

Thus the pulmonary tuberculosis of those beyond middle age is worthy of careful consideration, not only from the point of view of the practitioner—with whom rests the responsibilities of diagnosis and treatment—but from the Public Health standpoint, since every undetected case of "open" tuberculosis is a danger to the community by reason of the uncontrollable dissemination of bacilli. We constantly deplore the failure of young consumptives to put themselves under treatment sufficiently early to make cure possible; when we bear in mind the insidious onset of the disease, it is easy to understand the patient failing to seek advice or refusing full examination. In the pulmonary tuberculosis of older persons the presence of the disease is more often unrecognized from want of appreciation of the frequency with which tuberculosis occurs in lungs already damaged by the degenerations of age.

I am not disposed to lay down any dogmatic statement as to the age at which a person is to be considered old. For our present purpose age is a matter of degenerative changes in the organs rather than a question of years. I presume that no one who will confess to having reached the age of 45 years will take exception to being described as "middle-aged."

At this age the organs will show signs of wear, and for the



remainder of life the tendency is toward continuous and increasing changes of a "degenerative" nature. Many things may cause these changes to commence early or to advance rapidly. Mode of life, previous diseases, alcoholic excess, nature of occupation, etc., will make their mark.

The rule of life is, first, rapid development, a pause at maturity, and then degeneration; but, throughout all, there is constant, never-ceasing change. The dominant feature of this change, whether developmental or degenerative, must have its influence on functional activity and on pathologic changes in the tissues, and will thus to some extent impress and modify the symptoms and physical signs of any given disease.

The degenerations of age generally take either the fatty or the fibroid form, and the particular type present will influence not only the appearance of the individual as he grows old, but also the diseases of later life. It is, of course, common observation that as age advances some persons get stout and flabby, others become thin and shrivelled; but one may also note that the fatty persons are subject to a different kind of "age diseases" from those which attack the fibroid. Taking the lungs, for example, in the "fatty," bronchitis takes the place of chronic asthma—the dyspnea of fibroid lungs or small-lunged emphysema—which affects the fibroid degenerates. Again, we notice that the fat people are often lethargic in illness as they are in temperament. The stout bronchitic, for example, will bear without much cough an amount of irritation of the bronchial mucous membrane which would set up constant and violent cough in a thinner subject. These persons also are slow in recovery and slower still in recognizing that they have recovered, that is, in convalescence. Thus, the type of degeneration influences not only the nature of the age diseases, but modifies their course, and we may recognize different types in cases of tuberculosis in later life in the fatty and in the fibroid degenerates respectively, in addition to the clinical types due to differences in causation and extent of the disease.

The incidence of consumption among young adults is so appalling that we are likely to overlook the fact that the disease spares no age. It is common among children, and it is far from uncommon in the middle-aged and even in those who may be called old. If

we look at the tables of mortality we see that the deaths from phthisis, which for the age periods from 15 to 45 amount to 26,291 persons, still stand as high for the age periods 45 to 75 as 11,325 persons out of the much smaller number living at these ages. Even amongst the comparatively small number of persons who live to 75 years of age and upward, some 200 die each year from pulmonary tuberculosis.

ENGLAND AND WALES.—TOTAL DEATHS, 1902.

MALES					
Ages	15-45	45	55	65	75
Pulmonary Tuberculosis ....	3,837	1,078	571	183	24
Pulmonary Phthisis .....	10,657	3,273	1,673	587	77
Total .....	14,494	4,351	2,244	770	101
FEMALES					
Ages	15-45	45	55	65	75
Pulmonary Tuberculosis .....	2,708	507	252	91	20
Pulmonary Phthisis .....	9,089	1,743	961	406	58
Total .....	11,797	2,250	1,213	497	78

These figures, however, by no means represent the full number of those beyond middle age who are affected with tuberculosis of the lungs. As I have already mentioned, a large proportion of the older persons who have tuberculosis of the lungs are not recognized as being phthisical.

Of the subjects of pulmonary tuberculosis in later life some have brought their tuberculosis with them into middle age, having been infected while still young adults or become tuberculous when on the verge of middle age. These may be divided into two groups. There are, first, those who, having become infected, remain continuously ill, and at the age of 45 are suffering from active phthisis, acute or chronic; and second, those who have passed through an attack of pulmonary tuberculosis in earlier life which has become quiescent or arrested: these may enter middle life apparently healthy, and at least free from active phthisis. There still remains a comparatively large number who have become phthisical for the first time after they have reached or passed middle age. I shall refer later to a patient recently under my care who became consumptive for the first time when he was over 70 years of age.

Among the persons who live to old age there are some who have had pulmonary tuberculosis in earlier life, and who have entirely recovered but with a scar in the lung. It is important to distinguish between the results of an obsolete tuberculosis and a still active phthisis. In younger persons with the physical signs of solidification in the apex of the lung, the presence or absence of adventitious sounds (*râles*) in the lung and of symptoms of active disease, such as pulse and temperature disturbances, wasting, etc., will generally show whether the disease is active or not. In old people we cannot so much rely on such signs, for the lungs of old persons are rarely free from *râles*, and active tuberculosis in old people does not always produce such disturbance of temperature or such distinctive symptoms as may be met with in the young.

The older subjects of active tuberculosis in the lungs—both those who developed the disease before middle age and those who become phthisical late in life—will to some extent show modifications of type according as the individual belongs to the class of fatty or that of fibroid degenerates. Comparatively few of the fatty type will be found among those who enter middle age with active consumption: they will have died off before, since the tendency of the fatty type is to acute disease and rapid softening, not to the more prolonged chronic disease of the fibroid type.

One characteristic is common to all types of the disease in old people—the tendency is to advance and not to cure. The advance is usually slow, especially in fibroid lungs, but it is continuous and progressive: more rarely the advance is rapid (acute phthisis). The patient's condition may vary considerably—sometimes confined to bed and markedly ill, then periods of relative quiescence during which he may be up and about. I need not describe at any length the acute consumptive. Whether the patient be old or young, the clinical picture is practically the same in all, and it is unfortunately so common in this country as to be well known to everyone. The patient is confined to bed—or at least should be so—the cough is frequent and accompanied with the expectoration of yellow lumps, brought up with more or less facility, but sometimes causing retching or vomiting. The face is thin, with often a hectic flush on the cheek, the breathing is short or easily disturbed by any effort. The temperature has a wide diurnal range, and is persistently high;

night sweats are common and weakness extreme. Rest and good nursing may help to keep the patient alive for months, but emaciation is progressive, the strength gradually fails, and the inevitable termination seems almost a welcome release.

There is in such a case no question of overlooking the nature of the disease, and among all but the very poorest patients there should be little difficulty in having the necessary precautions observed to prevent danger of communicating the disease. Among the poor, however, these patients are frequently a source of danger, wherefor institutions for such consumptives are much needed, together with the requisite powers for the compulsory removal of patients when necessary.

It is in the more chronic type of pulmonary tuberculosis that the patient escapes control or is only intermittently under observation.

The chronic consumptives constitute a large class of chronic invalids. When they are known to be tuberculous the necessary precautions to prevent the spread of the disease to others are carried out while the patients are under medical supervision. Such cases among the poor go from hospital to hospital, and form a large proportion of the inmates of our Poor Law Infirmarys. Many of them are able to do a little work, with an occasional spell of rest when the disease becomes temporarily more active. They drag their weary way through their remaining years—few, or comparatively many, as the case may be—with gradually increasing weakness which at length confines them entirely to bed, and they die at length exhausted and worn out. Among the members of this group we may find almost all varieties of consumption.

A few will give all the symptoms and signs of acute or sub-acute tuberculosis—cough, with thick yellow expectoration, high temperature with hectic color and night sweats. Examination of the lungs may give us the large bubbling râles of acute softening in the greater portion of both lungs, with signs of cavities of various sizes. These are dangerous consumptives who, for the sake of others, require to be isolated if they are unable or unwilling to follow out the necessary precautions to prevent dissemination of their disease. In a much larger number the disease has settled down into the chronic condition. The growth of fibroid tissue in the affected portion of the lungs prevents rapid extension of the

tuberculous process, but the recuperative power of the debilitated invalid is insufficient to bring about complete arrest of the disease. In the older seats of disease cavities may have formed and then contracted, causing flattening of the chest and possibly displacement of the heart and other organs. Fever is slight or absent, with only occasional rises of temperature to 100° or over. Cough may not be severe, and the expectoration—sometimes slight, at other times copious—is generally greyish or clear and often frothy, with greenish rather than yellow lumps. These patients are often able to keep about for years, with few signs of active illness.

It is well to bear in mind that these patients may go on expectorating bacilli for years; they require constant supervision to prevent them forgetting or neglecting to destroy their phlegm. Slowly, but surely, their weakness increases, and, unless some intercurrent disease carries them off, they die of exhaustion.

Diarrhea is not uncommon; albuminuria often occurs; and hemoptysis is a frequent complication. These are the cases in which fatal hemoptysis sometimes occurs.

The picture of chronic phthisis is too well known to require more detailed description. There are, however, two points to which I would again direct attention. In the first place, there are some cases in which the tuberculosis has from the first been so slightly active that its onset may have been overlooked, and throughout its often prolonged course the presence of tuberculosis may then remain unrecognized. These are the "chronic asthmatics" who may be an unsuspected source of danger to others, and in all such cases it is well to examine the sputum for bacilli.

The second point is that we must guard against mistaking the signs of scars and old dry cavities for evidence of active tuberculosis; on the other hand, we must not mistake chronic tuberculosis for cured phthisis.

The chronic consumptive may not expectorate bacillary sputum at all times. There may be intervals during which the sputum is free from bacilli, though the tuberculosis is still active and bacilli will reappear in the expectoration later. In seeking to determine whether solidification in the lung presumed to be tuberculous is due to old mischief which is arrested or inactive, or whether it indicates the presence of still active tuberculosis, it is

well to bear in mind also the possibility that tubercle bacilli may, though rarely, be present in the sputum, though absent from the lung tissue. The "chronic consumptive" may, and frequently does, continue to expectorate sputum in which tubercle bacilli may be found long after all symptoms and other signs of active tuberculosis have disappeared. Such patients may continue to expectorate bacilli-containing sputum for months and possibly for years after the disease appears to have become arrested. It seems possible that the secretion in an old cavity, cut off from communication with the lung tissue around it by a firm fibrous capsule, may serve as a culture medium in which bacilli develop. Such bacilli are prevented from invading the lung tissue by the protecting wall of the cavity. The patient is, however, a danger to others, if he does not take precautions to destroy his expectoration, and he is in danger of becoming himself re-infected from the contents of his own cavity if his resisting power should become diminished by an attack of illness—as influenza, or by worry, etc. It appears possible that the secretion in a bronchiectatic cavity may become infected with bacilli, forming a sort of culture tube. Bacilli may presumably grow in such a cavity and yet never infect the lung tissue; on the other hand, lung infection may be brought about in this manner. I have seen a case recorded in which a cavity in the lung was supposed to be tuberculous because tubercle bacilli were found in the sputum. Yet after death no signs of tuberculosis could be found in the lung. The cavity was seen to be an enlarged bronchial tube (bronchiectasis) and its contents only were found to contain tubercle bacilli, none being found in its wall nor in the lung tissue, which showed no signs of tuberculosis. On the other hand, I have had patients with simple bronchiectasis—with no signs of tuberculosis—who have eventually developed tuberculosis in the lungs.

The freedom from signs of active tuberculosis in the subjects of old phthisis, even when they continue to expectorate sputum containing bacilli, suggests the possibility that like many other infectious diseases—as the exanthemata—an attack of tuberculosis produces a certain immunity against the special infection of the disease. We may observe many indications of such a tendency of the tuberculous process to produce a partial and temporary immunity against tuberculosis. It is noticeable how few, com-

paratively speaking, of those who suffer in early life from tuberculosis of the cervical glands (strumous glands) become consumptive subsequently. It may be that the local tuberculosis has produced a general immunity—as vaccination produces an immunity against variola. We may note a similar freedom from pulmonary tuberculosis in the great proportion of cases of lupus, of caries of the spine or of hip-joint disease. Only when the resisting power of the individual has been broken down by acute or prolonged illness do we find other organs infected secondarily. Certain American observers have suggested that far from tuberculosis being inherited, the children of tuberculous parents possess a certain immunity against infection. But, putting aside any discussion of inherited immunity, we have plenty of evidence in favor of the idea of a partial general immunity conferred on the body by a local tuberculosis. The human subject, though susceptible to infection from bovine tuberculosis, is far less so than to the invasion of bacilli of the human type. There is evidence pointing to certain local tuberculosis being caused by bacilli of the bovine type. It does not seem an overstretching of the imagination to suppose the possibility of eventually finding a strain of bovine, or possibly of avian tuberculosis—for human beings seem even less susceptible to bacilli of the avian than to those of the bovine type—which on inoculation would produce merely a local lesion while conferring a general immunity against even human tuberculous infection. If this should be discovered—and it has not yet been found, or at least not yet disclosed—vaccination against tuberculosis may become possible. If a mortality from small-pox of 1 in every 10 deaths from all causes was considered sufficient to justify compulsory vaccination, a similar proportionate mortality from tuberculosis (and that is about the proportion at the present time) might, if the “vaccine” were discovered, justify a similar procedure against the “White Plague.” I must apologize for this long digression, but it may provide food for thought.

We come next to the cases of renewal of activity in later life of a tuberculosis which has been arrested and may have remained quiescent for many years. We meet with patients who have had consumption in early adult life which has become apparently cured, and who perhaps twenty years or more later get an acute pulmonary

tuberculosis. It may be that they have remained free from any symptoms of their old lung mischief until they have reached the age of 50 or 60 years, and then perhaps some acute bronchitis or other lung affection lights up the old trouble. Here is a case illustrating this: The patient, a man of 46 years of age, who had been in the army in his younger days and had led an active and laborious life, was admitted into hospital with acute bronchitis and heart disease. The numerous bronchitic râles entirely masked any other signs in the lungs, but the temperature chart caused me to suspect tuberculosis. The man died suddenly from his cardiac lesion before the lungs had cleared sufficiently to allow of my suspicion to be verified by auscultation. At the autopsy an old tuberculous focus was found in the apex of the right lung, with recent and active tuberculosis in the neighborhood. The history seemed to fix the primary attack of tuberculosis in the lung about twenty-five years previously: the disease had become arrested, and had remained quiescent for all these years and had then lighted up afresh. This case also illustrates a point of some importance. The active tuberculosis could not be detected by physical examination because the chest was so full of bronchitic râles that they obscured all other sounds. The temperature chart aroused suspicion that there was tuberculosis, but we were not able to verify the supposition by the results of physical examination. This condition of things is by no means uncommon. We may suspect tuberculosis, but when we listen to the chest we may hear nothing but bronchitic râles. In such a case we must wait for the bronchitis to subside before we can detect the presence of tuberculosis by physical examination. In this connection let me suggest to you that when you come across a case of bronchitis and find the physical evidences of this confined to one lung, or much more marked in one lung than in the opposite one, suspect tuberculosis as the underlying cause of the bronchitis. You may not always find your suspicions confirmed, but you will, I am sure, do well to be on the lookout for tuberculosis whenever you find a localized bronchitis.

When an obsolescent tuberculosis lights up in later life its progress may be very acute and cause death in a few weeks: in other cases the process will be subacute and advance more slowly. We may note in this the difference between the fatty and the



fibroid degenerates, the former usually furnishing the acute cases, the latter the more chronic. It is this possibility of an old tuberculosis lighting up active mischief, after even thirty or forty years of quiescence, which makes us hesitate to speak of "cure" in consumption when the amount of mischief has been considerable, however completely the symptoms and signs of the disease may have disappeared.

Passing on from those individuals who, so to speak, have entered middle age, bringing their tuberculosis with them, there are still those to be considered who, having escaped infection in the more active part of life, become for the first time tuberculous after 45 years of age. Sometimes even an old person, with no marked antecedent lung disease and no noticeable evidences of the degenerations of age, may develop pulmonary tuberculosis. Here, for example, is a case in a man of 70 years of age. The patient, who had travelled much in various parts of the world, came under my care in April, 1905. He had been strong and in good health until about three months previously, when he "contracted a bronchial cold" and had not been able to get rid of his cough. At the commencement of his illness (January, 1905) he coughed up a little blood. Physical examination showed impaired respiratory movement and slight impairment of resonance on percussion at the upper part of the chest on both sides. A few crepitations were heard at the right apex. Later on tubercle bacilli were found in the sputum. He remained under sanatorium treatment for about three months, when all signs and symptoms of active disease had completely disappeared.

More frequently tuberculosis attacks a lung which has been damaged by repeated attacks of bronchitis, or the elasticity of which is diminished by fibrosis. The fixation of the chest in the condition of over-distension, which is so often to be noticed in old soldiers, from the artificial position which used to be considered necessary for a military appearance, seems to predispose to tuberculous infection of the lungs in later life.

A common history in patients who develop tuberculosis of the lungs in later life is that after a few weeks or months of dyspnea and cough the patient seeks advice, and when questioned admits that he has been troubled with a cough on and off for two or three years.

Examination shows some general fibrosis of the lungs, percussion gives a poor note and much resistance over the whole chest, but we may find that the dulness is more pronounced at one or both apices. Careful auscultation discloses some suspicious râles at one apex, different from those heard at other parts and unaltered by cough. If the temperature is taken regularly it may be found to rise to 100° F. or higher in the evening. These cases of pulmonary tuberculosis in old people are sometimes altogether overlooked, and occasionally are mistaken for subacute pneumonia or perhaps for influenza. The progress of the physical signs should decide the diagnosis, and the presence of tubercle bacilli in the sputum will confirm it. I was recently asked to see in consultation a man of 51, who had occasionally suffered from cough for several years, and was confined to his bed with what was supposed to be an attack of subacute pneumonia. There was dyspnea, cough, fever; the respirations were 32 per minute, the pulse rate 116, the temperature 99° to 101°. Physical examination showed diminished percussion note at the left base and many fine râles scattered through both lungs. On careful examination I found some moist crepitations above the left clavicle and gave the opinion that there was tuberculosis in the apex of the left lung, general fibrosis and emphysema, and a thickened pleura at the left base. The tuberculosis rapidly advanced and the physical signs soon became unmistakable: the patient died some few weeks after I first saw him.

Fibrosis of the lung—whether due to dust inhalation, to the degeneration of age, or occurring as part of the general fibrosis of chronic alcoholism—predisposes to pulmonary tuberculosis. In this connection it is interesting to note that, as I have recently heard from the Pathologist to the London County Council Lunatic Asylums, the chronic alcoholics nearly all die tuberculous. It is probable that stone-masons', knife-grinders' or miners' phthisis is at the commencement non-tuberculous, the results of simple reaction changes resulting from mechanical irritation (pneumokoniosis): the majority of such cases eventually become tuberculous. In the fibrous lung tuberculosis advances but slowly, the fibrosis preventing rapid extension of the tuberculous process. We know that the arrest of pulmonary tuberculosis is in many cases brought about by the formation of fibrous tissue in the affected lung, and that this fibroid

overgrowth is the safeguard of the chronic consumptive. Just as the formation of fibrous tissue is what we hope for, to cause limitation or arrest when tuberculosis has advanced to a certain stage in the lung, so when tuberculosis affects an already fibroid lung we may expect slow progress of the disease, though in these latter cases arrest is unlikely to occur. The disease progresses slowly, and these patients swell the ranks of the chronic consumptives. In these cases the presence of tuberculosis is sometimes overlooked, masked by the general signs of fibrosis. An individual who for some years has suffered from shortness of breath on even slight exertion, and who constantly has a slight cough which becomes intensified with every change of weather, may easily attribute an increase in his symptoms to the natural course of his chronic lung condition. Thus, when his breath becomes shorter, his cough more persistent and perhaps more violent, and his weakness and emaciation more pronounced, both he and his medical adviser may fail to suspect any added infection. In such a case as this we may, on physical examination of the chest, find that, in addition to the general want of resonance and increase in resistance noted on percussion, there is evidence of more marked and denser solidification at the apex of one lung. These cases are so common that I would suggest careful differential examination of the different parts of the lungs in all cases of fibrosis with cough and dyspnea. The sputum of such persons should also be examined for tubercle bacilli in order that the proper precautions may be taken if these should be found to be present.

With the chronic bronchitic also it is not always easy, as we have seen, to recognize the signs which show the presence of tuberculosis in addition to the chronic bronchitis and emphysema. Many of these chronic bronchitics are expectorating tubercle bacilli, unsuspected because they have not been recognized as subjects of tuberculosis. Here the difficulty in detecting the presence of the tuberculosis on physical examination is often considerable, because the bronchitic râles prevent any other sound being heard.

Here is a typical case showing how easily the presence of tuberculosis might be overlooked. A man, aged 62 years, had had a cough for twenty-six years, worse in the winter and more severe the last two years. He had been getting thinner for about five months.

He had never had any hemoptysis. The physical signs in the chest were indefinite, merely some dulness at the right base and a few scattered crepitations. Tubercle bacilli were, however, present in the sputum.

As already stated, tuberculosis often infects lungs which have previously become fibroid; on the other hand, fibrosis of the lung may be the result of tuberculosis. Local fibrosis is not uncommonly set up in the neighborhood of a tuberculous focus; it then tends to limit the extension of the disease and occasionally brings about arrest. Less frequently a more generalized fibrosis is set up by tuberculosis, but cases of true "fibroid phthisis" are comparatively rare.

As an example of this condition I take a man aged 44 years, who had had rheumatic fever twice (at 18 and 24 years of age) and who was well and at work until six or eight months before he came under my care. His illness commenced with weakness and wasting, and later cough with expectoration. His chief complaint was of dyspnea and weakness. He was emaciated and anemic, and the physical signs on examination of the chest were high-pitched and flat percussion note, increased vocal fremitus, especially on the right side, with numerous fine râles all over, and some larger crepitations at the apices. He died about nine months after the commencement of his illness. The lungs were so densely fibroid that they cut with difficulty, and under the microscope there was dense fibrous tissue with many giant cells. The liver showed a condition similar to that in the lungs. The old term "fibroid phthisis" included all cases of fibrosis of the lungs, whether tuberculous or not. In some of these fibroid lungs cavities may be present, not from destruction of the lung tissue as in acute tuberculosis, but from contraction of the fibrous tissue. In such cases much displacement of the heart may be caused.

*Treatment.*—It is unnecessary to enter into any detailed consideration of the treatment of pulmonary tuberculosis in the aged. The same principles guide us in the treatment of consumption in old persons as those which direct the treatment in younger patients. One question which is often asked is worthy of consideration, namely, are senile consumptives fit subjects for open-air treatment? Can they safely stand the exposure which younger consumptives endure with benefit? In dry warm weather or in warm and dry

climates all are benefited by being continually in the open air. In the English climate, however, those patients who have a tendency to bronchitis can rarely stand open-air treatment, and in damp weather they certainly do badly as a rule. The fibroid cases can stand the open-air life well except in the very cold weather. The young consumptive gets on best during the bright cold of the winter, but the old and fibroid patients cannot stand the cold. I have recently seen a patient who at 55 years of age has developed tuberculosis in the lung, and whose condition becomes bearable only in damp weather, when alone his cough is easy and his breathing comfortable. Some old persons, however, do well under thorough open-air conditions—like the patient of 70 whom I have previously mentioned; but all patients beyond middle age require careful watching when undergoing sanatorium treatment, and may have to occupy warm wards or dormitories. As to drugs, the ordinary remedies for chronic bronchitis are those generally useful for the senile consumptive. Small doses of iodide of potassium (one or two grains) are often advantageously added to the expectorant medicines when these are required.

The treatment of consumption in old persons is chiefly palliative. Much can be done for the patient's comfort and relief, but, as already stated, there is usually little expectation of cure. My old patient at 70 appears to be cured: in his case the disease was fortunately detected at its commencement and treatment commenced early. As a rule the mischief has been going on for some long time before it is recognized, and all efforts are unavailing to check it. In the fatty degenerates we may expect a more rapid and acute course than in the fibroids, but, whether fast or slow, advance is generally continuous. But though we can but rarely hope to cure the patient himself, we can prevent the extension of the disease to those with whom he is associated. Destruction of the sputum is most important, and it is the danger from the expectoration of unrecognized senile consumptives which justifies this attempt to emphasize the characteristic features of pulmonary tuberculosis as it affects the middle-aged and the aged.

## RECENT ADDITIONS TO OUR KNOWLEDGE OF THE PHYSIOLOGIC INFLUENCE OF LOWERED BARO- METRIC PRESSURE<sup>1</sup>

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ALTHOUGH the great monograph of Paul Bert upon the physiologic effects of varied barometric pressures was published in 1878, it is only comparatively recently that systematic studies have been made on the life of man at high altitudes. The time is fortunately past when one might venture to deduce from the principles of elementary physics and physiology the reactions of the infinitely complex human machine to changed environment. Those who, like ourselves, deal with vital phenomena at one to two miles above sea level, must gratefully welcome the investigation by trained observers with the use of exact methods as to what, if any, modification of living processes results from lowering the barometric pressure. In 1894 a distinguished Italian physiologist, Professor Angelo Mosso,<sup>2</sup> headed a party consisting of three scientific colleagues and a company of ten soldiers in a journey to the top of the Alpine Monte Rosa (elevation 14,960 feet). During the ascent and for a two weeks' sojourn at the height, elaborate observations with exact apparatus were made upon various physiologic functions. During the present year there has appeared a splendid contribution to the same subject, in a record of experiments and observations performed under essentially the same conditions as Mosso's, by four well-known German physiologists, Professors Zuntz and Loewy and Drs. F. Müller and Caspari.<sup>3</sup> The results of these investigators

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<sup>1</sup> Read at the meeting of the Colorado State Medical Society, Denver, October, 1906.

<sup>2</sup> *Life of Man on the High Seas*. Translated by E. L. Kiesow, 1898.

<sup>3</sup> *Höhenklima und Bergwanderungen*, 1906.

so closely harmonize that the facts developed in their researches may be accepted, for the most part, as free from error; and it has seemed to me that a useful purpose might be subserved by a brief review of the Physiology of High Altitudes, especially as developed by Professor Zuntz and his colleagues.

The first query which must occur to the student in this field is, What organs and what functions of the body are especially influenced by lowering of barometric pressure? Professor Zuntz and his colleagues close their remarkable memoir with the statement: "There is scarcely an organic system of our body (particularly when under the conditions of physical exertion) that is not affected in its function by high altitude."

**THE MECHANICAL EFFECTS OF LOWERED BAROMETRIC PRESSURE.**—Our conceptions of the influence upon the body of diminution of atmospheric pressure are inevitably founded upon our experiences with the cupping glass, into whose air-exhausted cavity the skin and subjacent tissues bulge in such an astonishing way. Elementary physics teaches that such a local tumor is only the result of the difference of atmospheric pressure within and without the rim of the glass. If the diminished air pressure were simultaneously applied to the whole surface of the skin and air passages, the gases in solution in the body would quickly find their way to the exterior and escape until their tension within the body just balanced their pressure on its surface, and the intermolecular pressure throughout the body would come to an equilibrium with that outside. If a bottle of champagne is allowed to stand upright the liquor will sooner or later become flat because the pent-up gas in solution gradually diffuses through the cork; but if the cork be drawn under proper conditions the fluid froths up from the sudden liberation of gas which has been contained in the liquid under high pressure. It is evident, then, that given sufficient time, equilibrium of pressure between the gas dissolved and the air outside may be established without a single bubble of gas being thrown out of solution, whereas a sudden release of the pressure is attended with all the mechanical effects of an explosion. Essentially the same experiment has many times been unwittingly performed on human beings. Artisans who work in air chambers under water, sometimes at the enormous pressure of three or four atmospheres, are

subject, often with fatal effects, to what has been called "caisson disease," the symptoms of which only manifest themselves during the period of decompression. The milder symptoms of the disorder include pains in the tendons and joints, while the graver involve paraplegia and unconsciousness. There is no doubt whatever that the more serious phenomena, at all events, are due to the sudden liberation of the gases, especially nitrogen, from solution in the body fluids, resulting in mechanical injury of the tissue elements, particularly of the spinal cord. By prolonging the period of decompression the dangers are completely averted. In the classic experiments of Paul Bert it was uniformly found that the higher animals, when submitted to increased air pressure corresponding to about 15 atmospheres (or three atmospheres of oxygen), die in convulsions of asphyxia, because with such an increase of oxygen tension the tissues can no longer appropriate this element; it becomes, then, a distinct poison. It has been found by others that breathing condensed oxygen at somewhat lower pressures produces inflammation of the lungs and air passages.<sup>4</sup>

On the other hand, we know of no limit to the pressure to which protoplasm can adapt itself provided that pressure is gradually acquired and equally distributed within and without its substance. Various forms of marine life, even as high in the scale as the oyster, have been found living at an ocean depth of 2,000 meters, or 200 atmospheres, and Roger found that bacteria were not killed at 2,903 atmospheres.<sup>5</sup> It has been found, however, as might have been expected, that when deep-sea fish are suddenly hauled to the surface, the air inclosed in their swim-bladder may expand so inordinately as to force the vesicle out of the animal's mouth. In a lesser but still an important degree, the intestinal gases of a man may expand on ascending to a higher elevation. Both theory and experience, therefore, lead to the same conclusion, namely: that when barometric pressure upon the body is altered there at once proceeds the establishment of an equilibrium between the internal and external pressures. When decompression is too

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<sup>4</sup>Leonard Hill *et al.* Recent Advances in Physiology and Bio-Chemistry. 1906, p. 239.

<sup>5</sup>Leonard Hill, *loc. cit.* p. 252.



sudden to permit the escape of dissolved blood gases by diffusion, they are suddenly thrown out of solution with destructive mechanical effects. On the contrary, when the change of superficial pressure is sufficiently gradual there is no marked disturbance of the equilibrium between the internal and external pressures. According to present accepted notions, therefore, the functions of the body may proceed without mechanical disturbance under a wide range of barometric pressure. This subject will be reverted to in a subsequent section.

**RELATION OF OXYGEN TENSIONS IN THE AIR AND IN THE BLOOD.**—It is well known that the oxygen of the blood exists, for the most part, in loose chemical combination with the hemoglobin of the red corpuscles. According to Foster's résumé<sup>6</sup> of the literature, oxygen begins to escape from its combination with hemoglobin when the partial pressure of oxygen in the air is reduced to something less than half the normal; that is, when the total barometric pressure falls from 760 mm. (at sea level) to 300 mm., which about corresponds to the barometric pressure at an altitude of 17,000 feet. That is, under ordinary conditions of life at low and moderate altitudes, up to say 6,000 feet, the blood contains an excess of oxygen far above the working needs of the body. Nevertheless, physiologic disturbances attributable to altitude are experienced long before there is a critical failure of oxygen determinable by physical methods. In other words, in our physiologic economy we are dependent on a great excess of oxygen beyond what would seem to be the rigid physical requirements of metabolism, very much as in our social life we need a *luxus* of the coin of barter far in excess of the absolute necessities of living. The physiologic, like the social, organism is the creature of custom and needs time and training to adapt itself to a change of conditions. Herein lies a truth of the utmost practical importance for us who have so constantly to deal with living mechanisms suddenly transported from the barometric pressure of sea level (30 inches or 760 mm. Hg.) to that of our mountain slopes (about 24½ inches, or 620 mm., at an elevation of one mile). Physiologic study of every organic system of the body points to the same conclusion, namely, that vital adjustment to these changed barometric conditions needs time

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<sup>6</sup>Text-book of Physiology, 1889, pt. 2, page 575.

and training; that, moreover, such adjustment is greatly impeded by every exercise of functional activity and is acquired most quickly and safely under conditions of absolute physical and mental rest. When the organism attempts to perform some unaccustomed task there is a waste of force along channels unessential to useful work and an expenditure of nerve-muscle energy far in excess of that needed to accomplish the purpose. As the task is repeatedly performed the nervous impulses become more perfectly coördinated, so that gradually all the energy evolved tends to be confined to the effective mechanism. Such sensory-motor coördination is the most striking outcome of training. The momentous value of training for the activities of the voluntary nerve-muscle system is familiar to all. No less important, it may be assumed, is a similar course of habituation for the economical exercise of the vegetative functions, as those of respiration, circulation and digestion. This appears to be an elemental truth in a profound subject. If these conclusions be true as to the healthy individuals investigated how much more intensely must they apply to the crippled constitutions with which we, as medical practitioners, commonly have to deal.

**THE RELATION OF BAROMETRIC PRESSURE TO THE FORMATION OF BLOOD CORPUSCLES.**—Let us now see, in a general way, in what manner the tissues and functions of the body react to the conditions involved in a life at considerable elevations above the sea. During the past decade many observers have agreed that the number of red blood corpuscles per volume in the veins and superficial vessels increases markedly with elevation above sea level and, accordingly, it has been held that lowered barometric pressure acts as a stimulus to the activity of the blood-forming organs. Ambard, studying the blood from the femoral artery of dogs exposed to diminished air pressures in a pneumatic chamber, found, on the contrary, a lessening in the number of erythrocytes.<sup>7</sup> There is reason to believe that no investigator has come nearer the truth in his conclusions on this subject than a former president of this society, Dr. W. A. Campbell, of Colorado Springs.<sup>8</sup> All observers agree

<sup>7</sup> Tissier in Cohen's *System of Physiologic Therapeutics*, vol. x, p. 145.

<sup>8</sup> W. A. Campbell and H. W. Hoagland. *The Blood-Count at High Altitudes*. *Amer. Jour Med. Sci.*, 1901, p. 654.

that the increase in the blood count is practically immediate, being found even in balloon ascensions, and that there is as quickly a return to normal on descending from a higher level. There is no other certain evidence of such extraordinary formation and destruction of the blood disks as these facts would imply. When we realize that the slightest impediment to the circulation through the heart and lungs must normally, as in cases of valvular heart disease, cause a heaping up of blood in the afferent vessels, it is evident that an estimation of corpuscles in a drop drawn from capillaries or veins must, under such conditions, lead to an apparent though spurious increase in the erythrocytes. It may be said in passing that the white blood corpuscles themselves are also subject to variations of distribution which give rise, in a given organ, to apparent leukocytosis or leukopenia without change in the total number in the body. Goldschneider and Jakob<sup>9</sup> found, for example, that when the number of leukocytes fell in a peripheral vessel from any cause, there was a corresponding increase in the leukocytes in the capillaries of the organs (*e. g.*, lungs). But Zuntz and his colleagues have produced incontrovertible evidence that diminished barometric pressure does in fact stimulate to greater activity the blood-forming organs. This they proved by microscopic demonstration of blood formation in the bone marrow at high altitudes. The number of embryonic red cells found in the bone marrow on the mountains is greatly in excess of that usual at sea level. The bone marrow at high elevations is a much more active tissue than on the plains. They also, as did others, showed that the total amount of hemoglobin in the blood of animals sojourning or born at high altitudes is greater to the extent of 20 to 30 per cent. than in similar animals studied on the plains. These changes do not reach their maximum at once, but proceed gradually (for several weeks). The younger the animal the greater is the proportionate increase of blood count. There are, however, unexplained differences in the individual reactions to altitude. The importance of these facts in relation to vital resistance in disease processes would seem to entitle them to a consideration which places them in the first rank.

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<sup>9</sup> Hill, *loc. cit.*, p. 429.

THE INFLUENCE OF LOWERED BAROMETRIC PRESSURE ON RESPIRATORY MECHANICS AND GAS EXCHANGE.—Of course, the effects of lowered barometric pressure upon respiratory mechanics and the oxidations of the body were prominent subjects of investigation. The amount of air entering and given off from the lungs was measured by an appropriate gas meter, which could be strapped upon the back of the person observed while exercising, and which was put in communication with the air passages through a tube ending in a mouthpiece. It was found, as a rule, that the oxidations of the body, measured by the amount of O absorbed and CO<sub>2</sub> produced, were increased with altitude, and that this oxygen consumption was proportionately much greater during muscular exercise at high altitudes. There developed, however, great individual differences as to the effect of altitude upon body oxidations. In some men the increase fails to appear even at an elevation of 14,000 feet, especially if reached through a number of stopping places; in others it appears at 1,600 meters (about 5,250 feet) altitude. It is especially worth noting that for like amounts of physical exertion, as involved in climbing similar ascents, the excess in oxygen consumption is extraordinarily less in trained than in untrained men. This is but one of many illustrations of the fact that training, or, in other words, acclimatization, results in an ability of the organism to adjust itself to the physical environment so that the efficiency of the body as a machine may be maintained at the highest level. Without going into technical details it may suffice to say that Zuntz and his collaborators have pretty well demonstrated that even slight oxygen deficiency in the atmosphere may so pervert metabolism that there heap up in the circulation an excess of autogenic poisons, incompletely oxidized products of intermediary metabolism, which irritate the vital nerve centers, especially those concerned with respiration. For most normal people the grosser disturbances due to oxygen-hunger appear at an elevation of about 13,000 feet, while exceptionally more than 22,000 feet may be tolerated. In conditions of anemia or disease of the circulation, dyspnea may be experienced even in middle altitudes. As the individual becomes habituated to the lowered air tension, the available oxygen of the body is more economically distributed to the living cells, probably through a

better adjustment of the processes of osmosis and circulation. It is worth noting that when one descends to the plains after a sojourn at a high level the demand of the body for oxygen for a considerable time decreases below the normal to an even greater degree than the oxygen consumption increased as a result of the ascent. It may be suspected that herein lies the physiologic foundation for the temporary extraordinary improvement we sometimes see in patients whom we send to sea level because the higher altitude proves too great a strain upon their vitality. This subject will be reverted to in the section on the nervous system. The facts set forth demand that clinicians shall insist upon a carefully adjusted course of acclimatization for invalids newly arrived from sea level.

The effect of lowered barometric pressure upon the rate and depth of respiratory movement also varies greatly with the individual's facility of physiologic adjustment. In the observations we are especially following there was usually a slight, more or less progressive, increase in the rate of breathing from sea level to the maximum height reached, 4,560 meters (or 14,960 feet). The increase commonly amounted to from 2 to 5 respirations per minute, the rate later returning to normal. In a certain percentage of people there was a slowing of breathing on the mountain top to the extent of 1 to 3 respirations per minute. The observations were made upon subjects resting quietly in bed before rising in the morning. The depth of breathing, measured by the volume of air inhaled at an ordinary inspiration, usually increased after ascent from sea level. Zuntz and others have found that with deep breathing the oxygen in the alveoli of the lungs is maintained at a higher tension than with shallow movements. Deep, slow breathing seems to be the concomitant of perfect training and adjustment to the conditions of high altitudes. Berson and Suring, who, with the aid of oxygen inhalation, were able to survive the highest balloon ascent ever made, 10,800 meters (about 35,435 feet), were carefully studied in Berlin as to their respiratory mechanics. While sitting quietly, the former breathed but 6 to 9 times per minute and the latter only 5 to 6 times, but the volume of tidal air reached the enormous values of some 800 c.c. in one case and differ in the perfection of blood supply to their vital nerve centers

as they do in their respiratory mechanics. But even here idiosyncrasy obtrudes itself, for in some persons the respiration is more shallow on the heights than on the plains. In general, it has been shown that lowered barometric pressure stimulates the respiration so that a greater volume of air enters and leaves the lungs in a unit time than at sea level. In the majority of unacclimated people the increased lung ventilation is already obvious at an elevation of 1,500 meters (4,921 feet), and becomes considerable above 2,500 meters (8,202 feet). It should be noted, however, that when the air volume breathed at the higher altitudes is measured under the barometric pressure of sea level, it is found that the absolute mass of air ventilating the lungs decreases markedly at the higher altitudes. When the effect of muscular exercise upon respiratory activity is compared at different altitudes it is found that with like outputs of exertion the whipping up of lung ventilation is relatively enormously increased at high elevations. Zuntz found that the air volume consumed in the performance of one meter-kilogram of work was almost uniformly increased with altitude. At an elevation of 2,150 meters (7,054 feet) there was in one case about a threefold volume of lung ventilation necessary as at sea level in doing the same amount of work, and in another, at 4,560 meters (14,960 feet) the air volume breathed was five times as great. When we consider that increased lung ventilation implies a corresponding activity of all the mechanisms of respiration and circulation, not to mention the remoter influence upon secretion and metabolism, it is clear why our clinical observation has so often demonstrated that, at the relatively high altitudes at which we live in Colorado, a given amount of physical work may in the unacclimated or invalid person produce disastrous consequences that would not have followed a similar feat performed at sea level.

Although an increased depth of ordinary respiration, leading to a greater girth of chest, is usual at high elevations, the so-called *vital capacity*, or maximum volume of air which can be expelled after deep inspiration, temporarily decreases to a marked extent, from 10 to 25 per cent., in mountain ascents. The explanation lies in the expansion of intestinal gases combined with muscular and nervous fatigue. After a few days' rest the vital capacity returns to normal.

**INFLUENCE OF BAROMETRIC PRESSURE ON PROTEID METABOLISM.**—Perhaps the most important contribution of Zuntz and his colleagues to the physiology of low barometric pressure is the discovery of the peculiar modification of proteid metabolism at high elevations. The growing man or animal lays on proteid material as the most essential part of the body-machine. But, under ordinary conditions, it is seldom that the proteid moiety of adult tissues is increased. It has been found, on the contrary, that a characteristic biologic influence of even moderately elevated regions is to stimulate the assimilation of nitrogenous material. Even at the height of 500 meters (1,640 feet) there is a perceptible laying on of proteid matter. At moderate altitudes healthy young and middle-aged persons may expect to increase their weight of albuminous (and presumably muscular) tissue. This effect is greatly enhanced by judicious physical exercise. At extreme elevations, as 4,560 meters (14,960 feet) the nutritive process varies in the other direction and there is an increased destruction instead of assimilation of proteid material. The critical elevation at which this occurs varies according to the individual constitution; in one person observed the critical height was below and in another above 2,900 meters (9,514 feet). In untrained or unacclimated people the increase of proteid disintegration occurs at much lower levels, as 1,600 meters (5,249 feet) to 2,200 meters (7,217 feet). In some cases it has been shown that after descent from a sojourn at 2,200 meters (7,217 feet) there is a farther tendency to laying on of proteid. As pointed out by Professor Zuntz, the association of these facts with the evidence already at hand as to the stimulation of blood regeneration at even altitudes of 400 meters (1,313 feet) to 500 meters (1,640 feet) we have a physical explanation of the peculiar mental and physical invigoration that commonly attends a sojourn in the mountains.

**INFLUENCE OF LOW BAROMETRIC PRESSURE UPON THE HEART AND CIRCULATION.**—There is no physiologic function which in popular estimation, and deservedly so, is more vitally affected by lowered barometric pressure than the circulation of the blood. Studies of blood pressures under such conditions are astonishingly lacking both in number and completeness. Gardiner and Hoag-

land<sup>10</sup> studied 22 young men at Colorado Springs, elevation 6,000 feet, and again after being transported by a cog-railway to the top of the neighboring Pike's Peak, elevation 14,130 feet. They found that, immediately after arrival at the mountain top, the average maximal arterial pressure had fallen from 126 mm. Hg. in Colorado Springs, to 121 mm. After a sojourn of 3½ hours on the Peak, some slight exercise having been taken in the meanwhile, there was a further fall of blood pressure to 118 mm. The corresponding pulse rates averaged 86 and 99 per minute. I have made a series of observations on the barometric relations of venous blood pressure by the use of Gaertner's method of noting the height, as regards the heart, at which a vein of the hand or arm collapses when the member is elevated. The results indicate that there is a positive increase of venous blood pressure in man at Denver, elevation 5,280 feet, as compared with sea level. Researches on this subject must take into account the velocity of blood movement as affected by barometric pressure. While in acclimated, healthy persons the pulse rate at considerable elevations is practically identical with the rate at sea level, its acceleration with physical exercise is proportionately much greater at high elevations. Unless the output of blood with each ventricular systole decreases in proportion to the acceleration of the heart beat, it must follow that high altitudes, at least under conditions of physical exertion, greatly increase the velocity of blood current, and, presumably, the flushing of the tissues with nutritive material. Erlanger and Hooker<sup>11</sup> argue that the pulse pressure, or difference between the maximal and minimal arterial pressures, can be used as a basis for calculating the velocity of the blood current, and it is to be hoped that studies of this factor as influenced by altitude will not long be wanting. It is not yet clear what relation to the circulation is borne by physiologic variations in the viscosity of the blood. The increase in number of blood corpuscles in high altitudes would seem, theoretically, to entail a proportionate addition to the internal resistance to blood movement; but this interesting subject does not appear to have attracted investigation.

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<sup>10</sup> Trans. Amer. Climatolog. Assn. 1905, xxi, 80.

<sup>11</sup> An Experimental Study of Blood Pressure and of Pulse Pressure in Man. Johns Hopkins Hospital Reports, vol. xii, 1904.



Zuntz and his colleagues found that while, with a given muscular exertion, the pulse rate increased more at even moderate elevations than at sea level, the effect of training was to compensate for this excessive acceleration and do away with it. They sound a warning, which must have for us a peculiar force, that at high altitudes, especially under conditions of physical exertion, the boundary which separates the normal from the pathologic heart action is exceedingly narrow and may easily be overstepped. Disturbances of nutrition and heart overstrain may gradually develop to a fatal degree without exciting any subjective sensation of illness or suspicion of danger. How full are the memories of each of us of needless fatalities from cardiac overstrain, lung edema, and physiologic breakdown in invalids who, newly arrived in our midst, buoyed up by the stimulation of the climate, indulged in exercise when they should have been at rest in bed. Physiologists have shown that fatiguing exercise leads to accumulation of blood within and dilatation of the heart. Professor Zuntz compared the shadows of the heart in two x-ray pictures of the same person taken, one after a strong inspiratory effort with mouth and nose closed, and the other during a strong expiratory effort. The skiagrams showed clearly that the thoracic organs contained much more blood in the first than in the second case. From the difference in the areas of the heart shadows it was calculated that the heart volume at the end of the modified inspiration was 400 c.c. greater than after expiration.

Professor Mosso was able to have demonstrated by means of the phonendoscope that the volume of the heart increased perceptibly as a result of the exertion of mountain climbing and that the dilatation apparently involved the right side of the organ much more than the left. It is hardly necessary to state the conclusion that, even in moderately high altitudes, we have a most potent means of either helping or harming a feeble heart. Much thought and labor have been bestowed upon the mechanical influence of lowered barometric pressure upon the circulation. The great physiologist, Haller, a hundred and twenty years ago, taught that in an atmosphere of lowered tension the blood was drawn to the surface and produced a turgor of lungs and skin. Of other investigators, one has claimed that the blood tends to stagnate in the lungs, another that those organs become more anemic with lowered barometric

pressure. But the more trustworthy observations seem to show that the mere lowering of barometric pressure has no direct mechanical effect on the circulation.

According to Zuntz the cyanosis and local bleeding from mucous surfaces which often occur at high elevations, are simply due to dilatation of the peripheral vessels brought on by lack of oxygen, which is in turn more or less dependent on cardiac fatigue. It may, nevertheless, be conjectured that the hydrostatic pressure of the blood plays a prominent part in the symptoms provoked by sudden lowering of barometric pressure. For with a given arterial pressure it would seem as if there must be undue congestion in those peripheral districts, lungs and skin, in which atmospheric decompression is initiated. It is evident that the mechanical problem is so intimately entwined with chemical and physiologic ones that its solution is far from easy.

**MODIFICATION OF SWEAT SECRETION IN HIGH ALTITUDES.**—The technical difficulties in the way of determining the relation of altitude to sweat secretion are very great. It is commonly stated by those who guess at facts that the circulation in the skin and activity of the sweat glands increase with elevation above the sea. Mosso found, on the contrary, that a resting man lost weight more slowly from the skin on the mountains than at sea level. Zuntz and his party, however, found that exercise at a moderately high elevation, 1,740 feet, produced much more abundant sweating than in Berlin. Training, however, greatly reduced this exercise-secretion and at the same time made it more effective in cooling the body.

**RELATION OF BAROMETRIC PRESSURE TO BODY TEMPERATURE.** The constancy of the body temperature is dependent upon the coördination of the mechanisms for heat production and heat dissipation. The effect of great altitudes, as 14,960 feet, is to raise the body temperature, in some persons, to over 100° F. This abnormal body heat gradually passes off with acclimatization. This effect is very much exaggerated as the result of muscular exertion. The clinical experience which makes us reluctant to permit fever patients to seek higher altitudes finds herein an experimental basis.

**EFFECT OF HIGH ALTITUDES ON THE FUNCTIONS OF THE NERVOUS SYSTEM.**—Even in popular estimation, no organic mechanism

of the body is more prone to react to the conditions of high altitudes than the nervous system. The chapter of Professor Zuntz and his associates on this subject will be endorsed by every clinical observer of experience. Varying with individual resistance and elevation above the sea, the tendency of low barometric pressure, manifested sometimes even at moderate altitudes, is to over stimulation and early exhaustion of physiologic functions in certain unacclimated persons. The climatic irritation tends to beget, especially in nervous temperaments, a peculiar restlessness which impels to continuous bodily exertion, the fatigue of which stimulates to further efforts rather than soothes to rest. There is no doubt whatever that even at the moderate elevation of Denver, one mile above sea level, many invalids, especially such as suffer from pulmonary tuberculosis, needlessly go to ground within a few days of their arrival on account of overstrain of the right heart, followed by pulmonary edema, brought on by thoughtless exertion. The mental anomalies may cover a wide range from sudden outbreaks of exaltation or depression to actual delirium. Our former colleague, Dr. J. T. Eskridge, came to practically the same conclusions from his own rich experience.<sup>12</sup> There is no prescription we are more prone to make for "overwrought nerves" than a change to a lower altitude, nor is there any which is likely to prove more successful. But it must not be overlooked that such patients would, for the most part, fall within the class of invalids in any climate and often all that is needed is a change of scene and mode of life *per se*. It is especially intended here to dwell upon the pathologic rather than the physiologic attributes of high climates. It is the unstable, the neurasthenic temperament which, when unguarded, is likely to suffer at high elevations. Persons of less irritable disposition, when overworked at sea level, probably can find no such refreshment as comes from a sojourn in the mountains. According to Zuntz, the abnormally stimulating effects of high altitudes is due largely to the intense illumination of the skin, especially on account of the large proportion of chemical rays in the solar light. Insomnia is apt to be provoked by this irritation, but following a sleepless night under these conditions one arises in the morning

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<sup>12</sup> New York Med. Jour., 1890, Trans. Amer. Clim. Assoc. 1892.

feeling much more refreshed than after a similar experience at sea level.

There is a strong popular impression that the effects of alcoholic potations are in all respects more pronounced in high than in low altitudes. The exact observations of Mosso and other competent observers are, however, directly to the contrary. Mosso found, for example, that 40 c.c. of absolute alcohol, in a concentration similar to sherry, given on a nearly empty stomach at an altitude of about 13,300 feet, in contrast to its effect at sea level, produced no stimulating effect, neither did it influence especially the action of heart or respiration.

Of special psychologic interest is the experimental finding of Galeotti that the deglutition center is more easily fatigued at high than at low elevations.

Frequent mention has been made in preceding paragraphs of the persistence of favorable metabolic processes, which have been initiated under the stimulus of moderately high altitudes, after return to the original environment. Persons manifestly going to ground with a more or less generalized tuberculosis frequently come to Colorado in the hope of cure; but, after a sojourn of some weeks or months, it is clear that the disease is progressing to fatal termination. The patient is sent home and, not infrequently, there is an immediate improvement in every symptom and the invalid takes, at least temporarily, a new grasp on life.

**AUTOINTOXICATION IN HIGH ALTITUDES.**—Recent pathologic chemistry has taught us that the critical symptoms of many of the diseases with which we have to deal are due to intoxication with an excess in the body of waste products which the organism is powerless to oxidize to their normal condition as excreta. Zuntz and others have developed the extraordinary paradox that though, at very high altitudes, the actual consumption of oxygen is greater than on the plains, there is a more or less marked accumulation of suboxidized "fatigue products" in the circulation which irritate the nerve centers and in turn affect metabolism. The production of these substances is greatly augmented by physical exercise, is subject to great individual differences, and is done away with after thorough acclimatization. In the work so frequently quoted in these pages there is reviewed the important researches of

Werchardt<sup>13</sup> on fatigue toxins. When an extract from the muscles of an exhausted animal is injected into a fresh subject, the symptoms of extreme fatigue or even death of the latter may be produced. When, however, the toxic extract is inoculated in very small but gradually increasing doses, the animal thus treated becomes finally immunized to the fatigue toxin. Wolf-Eisner<sup>14</sup> later, in discussing this work, suggests "that athletic training may produce an immunity to this toxin, and thus allow the trained athlete to perform much more work than the untrained." The immense importance of these conceptions in our clinical physiology, particularly as modified by life in high altitudes, can here receive but a passing mention.

#### SUMMARY AND CONCLUSIONS.

Professor Zuntz and his collaborators summarize their great work on the physiologic relations of barometric pressure by saying that in high altitudes "metabolism, especially during physical exercise, is exaggerated; the laying on of proteid material is favored. The activity of the heart is stimulated, the breathing is strengthened, both of them through the medium of the nervous system operating upon the heart and respiratory mechanism. Blood formation is increased and the skin trained to more energetic activity."

Their advice as to the classification of cases suitable or unsuitable for treatment at high altitudes is based partly upon theory, partly upon medical experience of the ages. Residence at moderately high altitudes is advocated for persons with pulmonary consumption, scrofula, anemia, general body weakness, chronic gastrointestinal catarrh, stagnation of blood in the abdominal organs and its effects, and intermittent fever. Statistical evidence is against the suitability of high altitudes for those suffering from acute catarrh of the respiratory organs, inflammatory affections of the lungs and pleuræ and their sequels, articular rheumatism and affections of the heart.

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<sup>13</sup> Ueber Ermüdungstoxin und Antitoxin. Münchener med. Wochenschr., 1904 u. 1905.

<sup>14</sup> Centralbl. f. Bakt., 1906, Bd. xi, p. 634. (Abst. in Am. Jour. Med. Sci., Sept. 1906, p. 496.)

The nervous and neurasthenic are likely to do ill. In arterial disease the circulatory excitement so common at high elevations begets danger, and cases of pulmonary emphysema are unfavorably affected. We will, however, subscribe to the admission of the authors that the clinical problem is so enormously complex that we must still depend upon empiricism for much of our application of climatic therapeutics.

This article was begun with the expectation of applying the physiologic deductions from the great series of observations and experiments which has been reviewed to elucidate the effect of altitude upon certain pathologic conditions, especially those of nephritis; but the subject matter is already too voluminous for this occasion.

In conclusion, I think that we whose life work is carried on at the moderately high altitudes ranging from 5,000 to 10,000 feet above sea level, must unite in a feeling of gratitude to those who, possessing the ability and the scientific training, have devoted themselves to the arduous labors which I have but superficially reviewed. Their results give a firm foundation in exact experiment to many of the clinical impressions which we have laboriously accumulated through years of toil. It is evident from their work, as from our own experience, that for every individual there is an optimum altitude up to which his efficiency as a machine improves and beyond which it is physically and vitally disastrous for him to go. It has been demonstrated with mathematical precision that in removing from a lower to a higher elevation the physiologic coördinations of the body tend to become disturbed and that their readjustment occurs most readily during a period of physical and mental repose. How vital is the significance of such a theorem to us who deal so often with the unacclimated invalid!

Finally, if deductive logic has any place in biologic problems, there is once for all demonstrated the error in the point of view of that increasing number of our colleagues who deny the specific virtues of resorts in high altitudes in the treatment of cases of certain diseases, including, especially, the majority of those who suffer from pulmonary tuberculosis.

## OBSCURE RENAL HEMATURIA

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It has probably been the experience of every surgeon who operates much upon the kidneys to encounter now and then a case in which exposure and section of the kidney performed for the relief of hematuria fails to reveal anything abnormal to the eye. It has perhaps been equally surprising, although much more gratifying, to find that such cases were nearly always greatly benefited by the surgical manipulation, although at the time the operation may have been regarded as abortive. This type of renal hematuria has been recognized since the earliest days of renal surgery, and has constituted a puzzling problem in which physician and surgeon alike have been interested. Obscurity in pathology at all times adds interest to clinical investigation, and this must be particularly true of a condition which is frequently only revealed in its real character at an operation undertaken for the removal of stone or the ablation of a supposedly tuberculous or otherwise diseased kidney. Such cases may truly be considered as lying in the borderland between medicine and surgery,—mainly medical, perhaps, in their interpretation,—frequently surgical in their treatment.

Although by no means possessing a common etiology, these cases have been grouped together under such names as “renal hemophilia” (Senator, Broca); “hematuria from healthy kidneys” (Klemperer); “mysterious hematuria” (Rovsing), and “essential renal hematuria.” The last designation, “essential renal hematuria,” is the term most employed, implying hemorrhage from kidneys which are free from demonstrable lesion. Our literature contains a rich collection of cases of supposedly essential hematuria. Even as far back as 1841, Rayer<sup>1</sup> devoted an entire chapter of his book to this subject.

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<sup>1</sup> *Traité des Maladies des Reins*, Paris, 1841.

The development of renal surgery to its present vantage ground has brought the subject again and again to the fore, until a literature of considerable volume has accumulated. The complete analysis of this material by Eshner,<sup>2</sup> and a more recent review by Fowler,<sup>3</sup> relieve me from the necessity of discussing the development of the subject. It is a significant fact that as time advances fewer and fewer cases of essential renal hematuria are reported, the majority of cases, which doubtless would formerly have been added to the records as typical examples, being explained on definite anatomic grounds as more exact methods of investigation have come into vogue. It is especially noteworthy that microscopic examination has revealed the existence of chronic nephritis in many of these cases, so that it may be said to constitute the most important factor in producing obscure renal hemorrhage. The tendency consequently is to limit the use of the term essential hematuria, and to incline to the view that every case, if carefully studied, will show some pathologic background, usually a chronic nephritis.

The term "essential renal hematuria" remains, therefore, merely a designation by courtesy, a tentative name to classify a loosely related group of cases which possess two features in common,—unilateral renal hematuria and an obscure pathology.

The principal advocate of a purely medical etiology for this symptom is Klemperer. He advanced the theory that the hemorrhage is due to vasomotor causes, his hypothesis being that there is paralysis of the vasoconstrictor nerves of the kidney, resulting in vasodilation and consequent diapedesis of blood elements. In defence of his point he cited numerous examples of hemorrhage from different organs of "bleeders," and called attention to the phenomena of vicarious menstruation. He presented clinical and microscopic reports of cases wherein no pathologic change was noted to account for the hematuria. Although it should, perhaps, be granted that the hollow organs of hemophilous subjects may readily become the seat of hemorrhages, the question may justly be raised whether this can occur spontaneously without preceding local lesion. The examples of obscure renal hematuria which have been submitted to operation, the kidney thoroughly explored and sections examined mi-

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<sup>2</sup> Amer. Jour. Med. Sciences, 1903, vol. cxxv, p. 636.

<sup>3</sup> New York Med. Jour., Nov. 25 and Dec. 2, 1905.



roscopically, have nearly all proved to be cases of more or less well-defined local renal lesions. Examples of unexplained hematuria which have not been submitted to operation cannot legitimately be classed as essential renal hematuria, since no measures were taken to eliminate bleeding from the pelvis or ureter, and by no means of excluding local anatomic change in the renal structure in available without exploring the organ. One fact alone is pointed out by Harris as conclusive evidence against the vasomotor theory of Klemperer, which is that in all cases in which proper local and microscopic investigation has been undertaken, the bleeding has invariably been found to come from one kidney. It cannot be altogether denied, however, that the nervous system plays a considerable rôle in the incidence of hematuria of this character. In several instances simple exposure of the kidney without section of the organ permanently arrested the bleeding, and in one unique case, reported by Potherat, a hematuria of five years' standing ceased after a simple ureteral catheterization. A severe recurrent unilateral hematuria has likewise been known to cease permanently under the influence of the nervous impression caused by preparation for operation. Granting, therefore, the influence of the nervous system, it should nevertheless be considered a secondary factor in the etiology, for any such influence, it would seem, must exert an equal effect upon both of two organs so closely interrelated in their nervous mechanism, as are the kidneys, unless there existed some local determining cause in one or other organ.

In the investigation of any case of this character cystoscopy, x-ray photography, and local exploration of the kidney by operation are necessary. Not only must the kidney be examined *in situ* to exclude abnormal mobility, but it must be thoroughly divided and palpated; the pelvis searched under strong illumination; the ureter catheterized from above; a section of the organ excised for histologic examination, and the urine examined bacteriologically, for it is now a well-known fact that bacterial infection of the urine without pyuria is not rare. If all these procedures could be systematically carried out in all cases of persistent unilateral renal hematuria without symptoms, it is probable that we would hear little of essential renal hematuria.

The anatomic lesions found in these cases of obscure renal hema-

turia are: Congenital malformations, abnormal mobility, unilateral nephritis, chronic Bright's disease, mechanical lesions and their effects, angioma, tuberculosis, cystic degeneration, and fibroid degeneration of the renal capsule.

I wish to direct attention to chronic nephritis as a cause of obscure renal hemorrhage—it being undoubtedly one of the most frequent etiologic factors. In 32 of Eshner's collected cases the morbid anatomy was carefully worked out. Ten of these 32 cases proved to be examples of some form of nephritis. In this connection care must be taken to draw a line of distinction between Bright's disease proper and nephritis confined to one kidney or to localized areas of renal tissue. Such a mistake has before now been made, and has led to much confusion and misinterpretation, especially in the matter of the operation of decapsulation of the kidneys for nephritis. Unilateral and localized nephritis *per se* is not productive of the cardio-vascular disturbances and toxemias of Bright's disease. It bears about as much direct relation to chronic Bright's disease as unilateral fibrous goiter does to Graves' disease, and that is practically none at all. A unilateral or localized interstitial nephritis may, however, cause morbid alterations of the urine, and it is in cases of this character that difficulty will arise in determining the nature of the case, as between a localized unilateral nephritis and genuine chronic Bright's disease. The absence of cardio-vascular changes and other general somatic indications will arouse suspicion and point to the advisability of ureteral catheterization or urine "segregation" to secure the urine for analysis from each kidney separately. Unilateral nephritis probably has its origin most frequently in obscure infections of the organ. Acute infection of the kidney, whether it be circumscribed or diffuse in its involvement of the organ, essentially constitutes a trauma in its effects on the gland structure. It is well known that a localized process of interstitial nephritis is usually set up by traumas of the organ. This is true of wounds, calculi, infections, ureteral obstructions, infarcts, gummas, etc. The degenerative process may be strictly circumscribed to small areas of renal tissue, or involve the major portion of the organ, according as the determining trauma has been slight or severe. Whether strictly localized to one portion of the kidney or more widely diffused, it is possible for nephralgic pains and hema-

turia to result from these morbid alterations. It is difficult to explain how hematuria may result from a localized area of interstitial fibroid change. Although unable to explain the fact adequately, clinical records show that a small patch of interstitial fibrosis may be the only microscopic change found in a kidney which has bled severely and persistently. The area of involvement may be so small as to escape the most careful search, and it is perhaps on this account that even to this day cases of "essential renal hematuria" with an unexplained pathology are reported.

One method of production is advanced by Fenwick to explain two of his cases of renal hematuria. He found at operation in each case the apex of one of the papillæ tipped with a villous-looking growth which proved under the microscope to be a varicose dilatation of the papillary plexus—in other words, a papillary angioma. Removal of this growth, with a sharp spoon, controlled the hemorrhage in both instances. He ascribed the vascular tumor to compression of the papillary vessels on the proximal side by a patch of localized interstitial nephritis, probably resulting from some preceding obscure infection of the renal substance. It is altogether probable that subacute and strictly localized infections of the kidneys are much more common than we now believe. The depurative function of these organs renders them peculiarly subject to bacterial infection. That they do not escape unscathed, we may infer from the scars and localized areas of inflammatory change which are frequently revealed at autopsy in cases without renal history.

The following case, although not typical nor perhaps a very convincing example of unilateral nephritis causing hematuria, may possibly serve to illustrate the point:

The patient, a physician, aged 43 years, had experienced two attacks of typical renal colic of the left kidney, the first twelve years and the second three years before consultation with me. Since the last attack there had been a good deal of loin-ache and discomfort in the left side, the patient asserting that he has seldom been in a condition of bodily ease during that period. The general health has remained unaffected and the patient is the picture of good health. There is no cardiac enlargement or arteriosclerosis, and the systolic blood-pressure averages 120 mm. (R. R., 9 cm.). There is no nocturnal urination. The kidneys are not palpable, but

there is distinct tenderness on deep pressure in the left renal region. The daily quantity of urine averages about 1,200 c.c., with a normal specific gravity. Albumin is present, and the urine contains blood elements and casts. No tubercle bacilli were found in the urine sediment. Repeated x-ray examination by an expert skiagrapher revealed a well-defined shadow in the left kidney in each of four excellent negatives. A diagnosis of renal stone with some associated nephritis was made. After the lapse of several months operation was undertaken by a competent surgeon. No cystoscopic examination was made previous to operation, for the reason that the patient declined to have one executed, preferring to take his chances without, and thoroughly appreciating the element of error in renal diagnosis without cystoscopy. The kidney was thoroughly exposed. It proved to be a normal-looking organ. There were no adhesions nor undue mobility. The capsule stripped easily. The organ was split and thoroughly explored, the pelvis searched, and the ureter sounded by catheter for its entire length. No stone was found, nor was any abnormality of the organ revealed by the thorough examination. Unfortunately, no tissue was excised for microscopic examination. Convalescence from the operation was perfect, and during the six months which have elapsed since that time there has been entire freedom from the troublesome backache and the urine is now almost entirely free from blood, although still containing albumin and casts.

In attempting to interpret this case, it has seemed to me that the left kidney was the seat of an obscure localized interstitial nephritis, set up by infection resulting from the calculous attacks of his earlier history. It may be claimed, because of the continued presence of casts in the urine, that the case is one of obscure Bright's disease. The normal appearance of the kidney at operation; the perfect renal elimination, and the absence of all systemic indications of Bright's disease would seem, however, to dispose of this claim. Interpretation of the case on the basis of unilateral nephritis resulting from preceding infection is rendered probable by the clinical facts of the case and by recorded observation. It is a matter of common experience to observe a rather sharp nephritis follow attacks of renal colic.

I have at present under my care a man who, during the past six

months has had three attacks of typical renal colic. The last attack endured for two days and necessitated the rather free use of morphin. Immediately following the attack, the urine was found to be loaded with albumin, and the sediment contained innumerable casts, much renal epithelium, and blood-cells. The albuminuria and cylindruria gradually diminished, and in ten days the urine was almost free from morbid elements. In this case there can be no question that the calculous attacks set up a rather severe unilateral nephritis. It has been my almost invariable observation to find casts and other evidence of renal involvement in cases of nephrolithiasis. A localized interstitial nephritis started in this way may cause albuminuria, cylindruria, or hematuria in after-life.

Hematuria without symptoms may occur during the course of chronic Bright's disease. It is especially likely to happen in cases marked by cardio-vascular degeneration and high blood-pressure. Under these circumstances the mechanism of bleeding from the kidneys is the same as when hemorrhage occurs from the nose, in the cerebral circuit, or the retinal circulation.

Broadly generalizing, there are three forms of renal hematuria in Bright's disease: One severe in character, and usually transient in duration; another, occult and prolonged; and a third type which results from severe congestion of the kidneys under the influence of toxic irritation. The last two varieties are probably always bilateral, the former usually unilateral. The first two are almost always entirely symptomless. The third is frequently accompanied by backache, even amounting at times to actual pain.

The occurrence of blood in the urine during the course of chronic Bright's disease has long been known, and small, usually microscopic, hematuria is recognized as a relatively common development. The possibility of profuse hemorrhage from the kidneys during ordinary chronic nephritis is very little appreciated in clinical circles, although such occurrences are by no means rare. Askazy<sup>4</sup> has recently collected 11 cases from one clinic (Lichtheim's). It is probable that the condition is far commoner than we realize owing to cases escaping a correct interpretation.

This form of severe and more or less transient symptomless hematuria in conformity with Type I of my classification is usually

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<sup>4</sup> Zeit. f. klin. Med., 1906, lviii, 433.

a late manifestation in chronic Bright's disease. This is easily understood when the forces concerned in its production—vascular degeneration and high arterial tension—are considered. Rupture of arterial twigs under these conditions is common enough in Bright's disease, and may occur in the kidneys, as elsewhere. The bleeding occurs suddenly, without premonitory or associated symptoms, and the amount of blood lost in a short time may be great and produce anemia. While the hematuria lasts, it is usually impossible to diagnose nephritis from the urine, general indications being our sole recourse to distinguish the cause of the bleeding. Hematuria of this type is usually one-sided. In such a case it is, of course, not warrantable to assume that the other kidney is sound. The severity of the bleeding may suggest the advisability of surgical measures. Under the circumstances, it is not necessary to insist that operation must remain the "*dernier ressort*."

I have taken from my case-records the following example to illustrate this type of bleeding in Bright's disease. The patient, a lady 71 years of age, suddenly developed a severe hematuria without symptoms, on February 26, 1898. There was no history of pain or bloody urine in her previous experience. The urine contained large amounts of blood, the filtered urine showing, of course, a copious albuminuria. The pulse was slow, regular, and very tense; the heart enlarged, with a grating basic murmur, probably due to aortic atheroma. Physical examination was otherwise negative. There was no pus in the urinary sediment. Absolute rest in the recumbent position and hemostatics were ordered. At the end of forty-eight hours a slight diminution in the amount of blood in the urine was apparent, and from that time improvement was steady, although slow. At the end of two months the urine was entirely free from blood. A persistent albuminuria and casts in the urinary sediment after the hematuria had passed furnished urinary evidence of a nephritis. There was no recurrence of the hematuria in this patient's subsequent history, death occurring three years after from cerebral hemorrhage.

The second type in my classification of hematurias occurring during Bright's disease may arise as a very early development in the history of the case, at times even constituting the only urinary symptom of the underlying nephritis. Unlike the preceding described form, the bleeding is not likely to be severe, the microscope being often

required for its detection. Although small in amount, the bleeding is usually persistent, and there may be paroxysms at long intervals of more severe hematuria. In some cases which have been reported, hematuria has apparently antedated by several years the full evolution of the disease in its general aspects. It would seem, however, that the length of time which elapsed in such cases between the occurrence of hematuria and the full-fledged disease warrants a reasonable doubt of the existence of a direct connection between the two. Associated with the blood in the urine will usually be found casts and renal epithelium.

The following case is cited as a more or less typical instance of persistent low-grade hematuria resulting from the renal changes of Bright's disease. This patient has been under my observation for a number of years. He is 43 years of age. He has slight cardiac hypertrophy, a somewhat sclerosed arterial system, with moderate elevation of systolic blood-pressure. He has had a number of attacks of chronic uremia. The urine is of low specific gravity, and contains albumin and numerous casts. There is always blood in the urine—sometimes enough to render it dark and cloudy, ordinarily in microscopic amount only. There is no tenderness of the kidneys on deep pressure, and x-ray examination shows no stone. Bacteriologic investigation of the urine proves negative. This low-grade hematuria has been a constant feature of this patient's urine for six years, to my knowledge. While it is increased by the irritation of intercurrent toxemias, it is not dependent on such factors, being continuously present in all states of health.

Toxic irritation of the kidneys, whether it is severe enough to cause nephritis or stops short of that point and gives rise merely to hyperemia, is capable of inducing renal hemorrhage. The toxins of the infective microorganisms are next to the chemical toxins—cantharides, turpentine, etc.—the most effective agents in the production of hematuria. In acute infective nephritis blood in the urine in some amount is quite the usual thing. The bacteria themselves, as well as their elaborated toxins, are capable of inducing renal hemorrhage when they invade the kidney. When the bleeding is of toxic production it is bilateral. If it is caused by bacterial invasion of the renal tissue, the hematuria is usually unilateral. Although hematuria from toxic irritation or bacterial invasion may occur in cases in which the kidneys were previously sound, it is much more

likely to develop if the organs are the seat of degenerative changes.

The following case is cited as an instance of toxic hematuria: A physician of good habits, with an excellent family history, had four attacks of severe symptomless hematuria at intervals of about eighteen months. The symptoms complained of during the attacks were backache and distinct evidences of general toxemia. At other times the urine was practically normal, except for the presence of a few casts, and no symptoms existed. There was no tenderness on deep pressure over the kidneys. X-ray examination and bacteriologic investigation of the urine proved negative. The type of toxemia observed during the prevalence of the hematuria was distinctly gastrointestinal. It became apparent on investigation of this point that it was possible to induce hematuria by directing the patient to eat freely of red meats, at the same time neglecting the bowels, which were somewhat torpid. Under these conditions, headache, backache and fever would appear, and the urine would become concentrated and be found to contain blood, albumin and casts. A mercurial laxative coupled with a non-proteid diet never failed to control the symptoms, and so long as meats were avoided or consumed in strictly moderate amounts there was no recurrence of the toxemia and hematuria. In this case there is established a direct connection between the hematuria and a toxemia induced by the ingestion of meats,—in all likelihood a bacillus coli commune activity. Intense renal hyperemia, with hemorrhagic extravasations, resulted from the action of these highly-irritating toxins from the bowel. It may even be possible that the kidneys during the periods of severe hematuria were the seat of an actual bacterial invasion. Such an event may be more common than we at present realize.

We may perhaps be justified in assuming the ability of an acute bacterial infection of the kidneys to cause hematuria. We observe analogous consequences elsewhere in the economy; for instance, in the lungs. It has recently been demonstrated that atypical infection of the lungs of tuberculous subjects by the pneumococcus is a frequent cause of hemoptysis. Many hitherto mysterious epidemics of hemoptysis observed within wards of hospitals and sanatoria for consumptives are thus explained. A hematogenous bacterial infection occurring in the kidneys may similarly supply an etiology for some at least of the obscure so-called essential hematurias observed from time to time.



# MYXEDEMATOUS INFANTILISM AND INCOMPLETE MYXEDEMA

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WHEN myxedema is well developed, there is little difficulty in its recognition; nevertheless there are doubtless many cases which, for one reason or another—a few for the lack of a correct diagnosis—go untreated. This is the more to be regretted, since the wonderful results of organotherapy have been proved. There are, however, cases—and their number is probably comparatively large—in which the diagnosis is not carried on the patient's countenance or in his stature, in which the characteristic signs of the disease are not patent. In France this latter group of cases has received greater attention than elsewhere—the so-called *formes frustes* of myxedema and myxedematous infantilism. The diagnosis in these cases is by no means always easy. Without a correct diagnosis the patients may be treated indefinitely with little or no benefit to themselves, to say nothing of the disappointment to the attending physician; whereas with proper therapy complete relief is the rule in a few months or years, at the most.

Before discussing the conditions at greater length, it may be well to give the notes on a case which we have had the opportunity of observing in the medical wards of the University Hospital at Ann Arbor. The case is of interest not only because of the myxedematous infantilism from which the patient was suffering, but also on account of the association of double cataract, horny excrescences on the skin, and ulcers on the feet.

P. W. S., a male, aged 48 years, married, German-born, a farmer, was transferred, on May 26, 1904, from the Dermatological Clinic (Dr. Breakey), where he was being treated for chronic

ulcers of the feet, to the Medical Clinic for examination and treatment of his general condition.

*Family History.*—The patient's father died of "diabetes," at the age of 61. His mother died of "heart disease" at 64. One brother is living and well. Two brothers are dead; cause unknown. The parents and brothers were all of average size.

*Personal History.*—The patient remembers having had none of the acute infectious diseases during childhood, and says his health was good. At the age of 15 or 16 he had "dumb ague;" "scarlet rash" at 20; "mumps" at 30. For a time after this last illness he had slight stomach trouble, which has not persisted. At 32 he had "catarrhal inflammation" of both eyes; since then the vision has gradually failed. In the Ophthalmological Clinic of this hospital, Dr. Carrow removed a cataract from the patient's right eye nine years ago, and two years later he performed a similar operation on the left eye. The patient says he is the father of one child.

*Present Illness.*—The patient came to the hospital because of ulcers on the legs. Four years ago he had a "corn" on the ball of the left foot. A running sore developed at this point, which was closed temporarily by treatment. The scab soon became loosened and the condition was shortly as bad as before treatment. Later permanent healing took place. In the fall of 1900 the patient developed an ulcer on the left heel; it became about the size of a silver half dollar. It has never healed completely. Next a similar condition appeared on the outer side of the left ankle, and extended down almost to the sole of the foot. After about a year's treatment this disappeared. About two years ago the patient began to take on weight; he has not been weighed, but thinks he became considerably heavier. Several months ago a sore appeared on the inner side of the left ankle; it is still present. On the first day of January, 1904, a "bunion" on the ball of the right foot became an open ulcer. Aside from the sores on the feet and ankles and the eye trouble, the patient says he feels fairly well. He has no symptoms on the part of the digestive tract. There is no dysuria.

*Physical Examination.*—May 27, 1904. At 4 p. m. yesterday the temperature was 98.6° F., pulse 78, respirations 24. The patient is in the active dorsal position. The mind is clear, but the patient answers questions slowly. The memory seems fairly good.

The frame is very small; height about 5 feet (Fig. 1). Previous weight not known; present weight 98 pounds stripped. The hands and feet are very small, the long bones are slender. The pelvis is not wide. The patient presents a cachectic appearance. The skin is dry, rather harsh, and is desquamating in fine scales. Over the trunk it is of fair color, while the extremities, particularly the legs, show a mottled cyanosis. The hair is gray and rather thin on the head. There is no hair on the thorax or in the axillæ; on the face it is very scanty, while there are only a few hairs scattered over the pubic region. About the right olecranon process the skin is reddened, but not shiny or hot; the central part of the reddened area, which is about the size of a fifty-cent piece, is covered by rather thick scales. The skin here feels slightly thicker than that of the surrounding parts. Over the left olecranon process there is a similar condition, but less extensive. On the buttocks (Fig. 2) the skin is reddened, but not indurated, over an area about  $1\frac{1}{2}$  inches in diameter; in the central part of each there is a somewhat round, grayish-yellow, rather conical mass, dry, rough, and about  $\frac{1}{2}$  inch in diameter, elevated about  $\frac{1}{8}$  inch above the surface (cornua cutanea). The skin of the knees is slightly reddened, dry, scaly, and thickened. On the lower half of the legs and feet the skin is dry, scaly, indurated, and adherent to the deeper structures. On the right foot there is an ulcer over the external malleolus about  $1\frac{1}{4}$  inches in diameter, round, with rather ragged edges, of a pale red color, and covered with a seropurulent exudate. There is another smaller ulcer about  $\frac{1}{2}$  inch in diameter over the distal end of the first metatarsal bone, a portion of it protruding from the ulcer's base. On the left foot there is a crescent shaped ulcer about  $\frac{3}{4}$  inch long and  $\frac{1}{3}$  inch wide over the external malleolus; the edges are ragged and the bone protrudes from the base. There is a slight purulent discharge. The distal end of the fifth metatarsal bone is exposed, the skin being dry and discolored around it. Over the left internal malleolus there is an ulcer about  $\frac{3}{4}$  inch wide, with seropurulent discharge. There is ankylosis of the joints of the feet and ankles. The mammary glands are large. The subcutaneous tissue is very abundant. It is about 1 inch thick on the abdomen and about  $1\frac{1}{2}$  inches thick just below the mammæ. It gives to the skin everywhere a thick, leathery feeling. There is nowhere any pitting on pressure. The muscles are very small and soft.



**FIG 1.**—Myxedematous infantilism.



FIG. 2.—Myxedematous infantilism. A horny excrescence on the right buttock.

The skin of the face is dry, remarkably free from lines, and on the cheeks it is slightly flushed. There are a few dilated venules on the cheeks and nose. The eyelids are bluish-red, especially the right upper; they are not particularly thickened. The right cornea is opaque. Iridectomy on the left. The conjunctivæ are deeply injected; the scleræ are clear. The skin of the nose is slightly cyanotic; the epidermis is dry and desquamating. The lips are not thickened; slight sordes. The oral mucous membranes are of fair color. The teeth show considerable caries. There is marked pyorrhea alveolaris. The gums are retracted, bluish-red, and swollen. Marked *fætor ex ore*. The tongue is moist, has a thin white coat, and is rather thick. (Patient allows tongue to remain protruded for some time after examination of it is completed.) The neck is short. The thyroid gland is not palpable. Above each clavicle there is a pad of subcutaneous tissue, that on the left being somewhat the larger. The thorax is rather broad for the patient's height. There is a slight Harrison's groove, and the lower part of the sternum is slightly depressed. Expansion is very slight, the thorax moving *en masse*. The lungs are clear on percussion and auscultation. The heart is negative on percussion and auscultation. The pulse is regular, of fair size; the systolic pressure equals 166 mm. Hg.

The abdomen is on a level with the ribs with the patient recumbent; when erect, it is slightly protuberant. The umbilicus is depressed. The muscles are quite rigid all over, but there is no localized increase in rigidity, no muscle spasm or tenderness. The spleen and liver are not felt. There is tympany everywhere. The external genitalia are very small, approximating in size those of a child.

On May 31 the red blood cells were 4,160,000; the leukocytes, 4,074, and the hemoglobin, 90 per cent. The urine was negative.

On June 2, thyroid extract, 20 grains daily, was given to the patient. The dose was increased on June 13 to 25 grains daily, and the patient was kept on this until his discharge, August 18, 1904. On discharge there was a quite noticeable change in his condition. He answered questions with no hesitation whatever, whereas formerly he had been very deliberate; and he seemed much more alert mentally. His skin was moist, frequently flushed, less thick, and not desquamating. The pulse had increased in frequency.

The patient had lost fifteen pounds in weight. The ulcers on the legs, while not healed, were much improved, so that the patient was able to walk with a cane for the first time in several months. The systolic blood pressure on discharge was 150 mm. Hg., a fall of 15 mm. after receiving twenty-five grains of thyroid extract daily for nearly three months. It is greatly to be regretted that no x-ray negatives were made of the long bones. A continuance of the treatment was ordered for the patient, but since he left the hospital repeated inquiries addressed to him in regard to his health have been unanswered, so that I do not know what his present condition is.

Cataract is infrequent in myxedema; in the committee's report to the Clinical Society of London it was present in one eye in three out of eighty-three cases, the ages of the patients being respectively, 40, 38, and 58 years. In our patient the cataract was removed from the right eye at the age of 39, from the left at 41. In the same report warty growths of the skin were not very rare, but in the available literature I have found no instance in which ulcers of the feet and ankles were associated with myxedema, as in the case herewith recorded. It is unfortunate that the feet were bandaged when the photographs were taken.

All cases of infantilism do not come under the heading of myxedematous infantilism. The French make two main groups: the one, infantilism of the type of Lorain; the other, infantilism of the type of Brissaud, or myxedematous infantilism. Some writers, as Hertoghe, recognize transition types between the two.

Meige gives the following as the main features in infantilism of the type of Lorain: "The patient is short of stature—one thinks one sees a child; but stripped, the form is no longer that of a child; one would say rather that of an adult seen through the large end of an opera glass. His shoulders are large, the pelvis narrow, the bony landmarks well marked; the muscles, while not large, are well formed." In fact, we have before us a man *en miniature*. There is, however, absence of hair on the face, axillæ, and pubes, and the genitalia, though small, are nevertheless well formed and proportional to the rest of the body. The epiphyses are united to the diaphyses. In women this type of infantilism produces alterations similar to those in the male. The patient is reduced in size, but the relative proportions of the parts of the body to one another are

those of the adult. Frequently there is an absence of the secondary sexual changes. The intelligence is usually normal or slightly below the average.

Of etiologic factors in infantilism of the type of Lorain, the infections play an important role. Of these tuberculosis is probably the most frequent cause. Ferannini has reported two cases supposedly due to it. Fournier has pointed out the frequency with which syphilis produces infantilism. Chronic malaria, rheumatism, erysipelas, influenza, measles, scarlatina, leprosy, and diphtheria are less frequently encountered causes of Lorain's type of infantilism. Chronic intoxications are also looked upon as being of important etiologic moment. Alcohol seems to be the most potent of these; less frequently chronic poisoning with lead, mercury, carbon disulphide, nicotin, and morphin have been noted. Finally, and of great importance, are congenital or early cardiac lesions, such as persistence of the ductus Botalli or mitral disease, as Ferannini has well shown.

Myxedematous infantilism was first well emphasized by Brissaud. Cretinism is, of course, distinct from the condition which Brissaud described. It was noted by him that many children and adults present a condition which, after careful and painstaking clinical research, he concluded must be due to a thyroid insufficiency developed during childhood. This insufficiency may result in a total suppression of secretion from the gland or in a partial suppression of the normal secretion. Depending on the degree of insufficiency in the thyroid gland, then, there may be great variety in the extent of its manifestations, from the outspoken cases of myxedema to the mild or incomplete forms. It is the latter, especially, which Brissaud has brought to the foreground.

It is a well-known fact that absence of the thyroid gland or suspension of its function from any cause during childhood brings about an arrest in the development of the individual, together with other functional and nutritional changes. Horsley was among the first to demonstrate this experimentally. Recently Roger and Garnier have again shown this to be true by cutting off the blood supply to part of the thyroid gland in half of a litter of puppies, the remainder being kept as controls. In the operated dogs there was a marked stunting of the growth, the hairs remained short and became



stiff and brittle, etc., while the controls, living in the same cage, were quite normal. In man we have direct evidence of the same phenomena by the numerous cases of cretinism and myxedema in childhood which improve and become well under the continued administration of thyroid extract, relapsing as soon as the treatment is stopped, but remaining in good health so long as it is continued.

When myxedema is not congenital (cretinism), some etiologic factor must be sought which operates to suspend, partially or wholly, the function of the thyroid gland. In the operative cases the condition is perfectly clear; so, too, in patients in whom myxedema follows a carcinomatous infiltration of the gland. In the acute infectious diseases, such as typhoid fever, scarlet fever, rheumatism, and pneumonia, an acute thyroiditis may occur; this in turn may lead to a subsequent atrophy of the thyroid gland, as has happened in a few cases, with a resulting myxedema. But cases have been attributed to an acute infectious disease when no local signs of a thyroiditis were found. Such a case is the one reported by Bézy and Stoianoff, in which a myxedematous state developed shortly after an attack of measles. That the measles may have had something to do with the myxedema is not at all impossible, but at the present time it is quite incapable of being proved. It would seem far safer to attribute only those cases to the acute infectious diseases in which a definite local inflammation of the thyroid gland has been manifest. Alcoholism and pulmonary tuberculosis in parents predispose to myxedematous infantilism in the offspring, according to Bourneville; but when one considers the great frequency of alcoholism and pulmonary tuberculosis and the comparatively extreme rarity of myxedematous infantilism, this contention seems untenable. The disease has at times followed exophthalmic goiter, and occasionally seems to be hereditary. In the majority of cases of acquired myxedema one is forced to admit ignorance of the cause of the insufficiency of the thyroid gland. Bricquet has advanced the hypothesis that the condition is due to a congenital defect. "As a result of congenital malformation," he says, "certain individuals are born with a thyroid gland too small, insufficient from the first or absent (cretinism) or only becoming insufficient later, at a time when the needs of the body in thyroidin are increased (infantile myxedema,

myxedema of adults).” In this way he also explains the greater frequency of myxedema in women (90 per cent. of all cases, according to Ord), to whose sexual life the thyroid gland is so intimately related.

The clinical picture of fully developed myxedema, either in child or adult, is well known and only the salient points need be briefly mentioned. There is impairment of the intellect, sometimes amounting to dementia; the speech is usually slow. The skin is dry, harsh, and leathery. The subcutaneous tissue is greatly increased in amount and there are frequently cushions of it above each clavicle. There is no pitting on pressure, as in ordinary edema. The face is very full, rather round; the features, especially the nose and lips, are thick and heavy. The cheeks often present a flush. The tongue, as a rule, is thickened. The hair is scanty and dry. The body temperature is usually subnormal and the patients suffer greatly from cold. With an outspoken case, then, there is usually little difficulty in arriving at the correct diagnosis. Unfortunately, however, the clinical picture is not always frank, for there are all grades of myxedema, depending on the degree of thyroid insufficiency, just as in valvular disease of the heart the evidences of incompensation may be trifling or great, from a slight edema at the ankles to a general waterlogging of the entire body.

In many cases of incomplete myxedema or myxedematous infantilism—*formes frustes*—the correct diagnosis can only be made by the most searching physical examination in conjunction with a carefully taken history. In fact, the latter may give the first hint as to the real condition of the patient, for there may be noted frequently a defective memory, evidences of slow cerebration, or an irritableness, which are not uncommon in this disease. But the main reliance must be placed on the physical findings. These may be sufficiently well marked to allow one to make the diagnosis, or they may be only suggestive. In the case herewith reported the former condition existed; there the leathery consistence of the skin, with the absence of pitting on pressure, first suggested the condition. In the mild forms of the disease there may be an absence of the supraclavicular pads and the face may not show the characteristic features of the myxedematous. Thinning and dryness of the hair is only a suggestive symptom. A subnormal temperature of long duration is of some aid. It is, however, self-evident, it seems, that in

some cases of incomplete myxedema it may be impossible to make the diagnosis. Given a case in which the whole clinical picture is suggestive of myxedema, but not conclusive, one is justified in cautiously using the therapeutic test, that is, administering thyroid extract, beginning with a very small dose.

Myxedematous infantilism is a condition in every way similar to myxedema of adults, presenting both fully developed forms and *formes frustes*. The name in reality simply refers to myxedema coming on at a certain time of life, namely, between infancy and puberty. Thyroid insufficiency appearing in infants produces cretinism; in children, myxedematous infantilism; in adults, myxedema. Brissaud has emphasized the fact that the stature of a patient in whom a thyroid insufficiency has developed during childhood corresponds to his size at the age when the disease first appeared; there is an arrest of development, mental as well as physical. Thus in a patient of mature years suffering with myxedematous infantilism, as in that shown in the illustrations, we find not only the small stature but other marks of childhood,—that is, the lack of the physical changes of puberty. The external genitals are undeveloped, no hairs or few grow in the suprapubic and axillary regions and on the face, the head is proportionately large as in the child, the frame delicate. In addition to these there are the signs and symptoms of thyroid insufficiency, their degree corresponding to the state of the thyroid gland. The Röntgen rays are of some assistance, for, as in achondroplasia, there is a persistence of the epiphyseal cartilages in myxedematous infantilism. This may be of some value in differentiating the two varieties of infantilism alluded to above, though one must remember that both may be found in one and the same patient, as in a case reported by Dupré and Pagniez.

To summarize briefly, the diagnosis of incomplete myxedema is by no means always possible. In the doubtful cases the therapeutic test may be employed, the patient being kept under close and constant observation. Myxedematous infantilism of adults may be recognized by, (1) the existence of some or all of the symptoms and physical signs of myxedema, (2) the short stature, (3) the lack of development of the sexual organs, (4) the persistence of the epiphyseal cartilages, and (5) the improvement under the administration of one of the preparations of the thyroid gland.

## SYPHILITIC AORTITIS

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SYPHILIS of the aorta has been made the subject of numerous and interesting publications, and I myself devoted several chapters to it in my "Clinics of the Hôtel-Dieu." So that to-day it is not my intention to take up again this vast question in its entirety, but only to touch on a few aspects of it that seem to me to present a certain interest.

Eight years ago there came into my ward a policeman of forty-five, who for some time past had suffered from such severe cardiac pain and distressing sensations of stifling, that he had been obliged to abandon his work. It was impossible for him to wear his uniform buttoned-up. As soon as he walked or made any effort, and sometimes without apparent cause, he was seized with an attack of angina pectoris with all its concomitant symptoms. During these crises, said the patient, it seemed as though his thorax was squeezed in a vise or crushed by an enormous weight; suffering was excruciating, and the pain, starting from the cardio-aortic region, radiated in different directions, particularly into the shoulder, arm, and hand. When the crisis ended, the arm remained benumbed and inert.

The patient related that these attacks were not all similar; that in some the pain was less, and that the crises of angina consisted mainly in such intense oppression that he was afraid he was suffocating. His condition had become intolerable of late; he could no longer make the slightest movement, could not sweep out his room, could not walk even very slowly from one tree to the next as is the policeman's wont in his peregrinations, without being seized with pain and suffocation.

This case of angina pectoris was associated with aortitis, damaged aortic valves, aortic insufficiency, and the characteristic murmur with the second sound. As the patient had had syphilis

eighteen years previously I concluded that this was a form of syphilitic aortitis and prescribed injections of biniodide of mercury.

A first series of twelve injections was administered, and, twelve days later, a second similar series,—each injection containing only four milligrams of biniodide. The improvement in his condition was then so remarkable that the patient asked to be allowed to leave the hospital, but a month later he returned again, and a third series of twelve injections was given.

By this time the man, who three months previously could not take a few steps without being seized with a terrible attack of angina pectoris, could walk and even go upstairs without the slightest difficulty, and he was now able to conform to all the exigencies of his position in a perfectly regular manner. Five months later, feeling that the sensation of suffocation was returning again, he once more came to the hospital; fourteen more injections were then given, after which he left us in a more satisfactory state than ever.

Up to this point there is nothing very remarkable in this case, but from now on it acquires its fullest interest. During seven years I did not hear of this man again, when last September he appeared at the hospital once more; I recognized him at once and inquired about his health, and his answer was as follows: "During these seven years I have not suffered at all,—neither pain nor oppression; I have retired to my native village in the country, where I work on my place and go out by the day to work for others. I am in perfect health; there is not my equal for miles around me; I dig and work the entire day, and in the summer I can even harvest from four in the morning until eight at night."

Such was the report of this man whom we had treated seven years previously for such serious angina pectoris that an early and fatal ending seemed unavoidable. But fortunately for him this angina was of a syphilitic nature, and the injections of biniodide of mercury had effected this most satisfactory recovery,—a wonderful drug and a wonderful therapeutic method! As for his valvular lesion, it was still present, with the same murmur of aortic incompetence that we had heard seven years before, though it seemed to be quite harmless. This man soon left again for the country to resume his work for himself and for others; perhaps I

may see him a few years from now, still in this excellent condition of health.

In May, 1905, there was brought into my wards a man that had been picked up in the street apparently dying, having fallen down from the agony of a pain that had suddenly seized him in the heart, with great distress and sensation of strangling. He had had a most serious attack of angina pectoris, but it gradually passed off and by the next day the patient was able to give us the following details: his first attack of this nature had occurred four years previously; he had fallen in the street, so terrible had been the pain, and had been carried to a hospital where he was put on a prolonged course of potassium iodide, although he was quite affirmative about never having had syphilis. Since that time other attacks had occurred at various intervals, manifesting themselves particularly by a feeling of strangulation with pain in the precordium and down both arms along the line of the ulnar nerve.

These grave attacks would come on wherever the poor man happened to be. Then one day he was seized in a railway carriage, from which he was lifted out seemingly in a moribund state. Another time the same thing occurred in a restaurant, whence he was transported to a neighbouring drug-shop where everybody expected to see him succumb. In the last four years he has hardly ever slept, gets up at night because he cannot breathe, while any sudden movement or any protracted fatigue brings on a more or less severe attack.

To what could this case of angina pectoris be due? I immediately thought of syphilitic aortitis, because angina pectoris coming on in a man still young, between forty-five and fifty, is almost always due to a syphilitic lesion of the aorta. Our patient denied absolutely having ever had syphilis, but in spite of his denials a close examination showed that this was the correct diagnosis, for we found that he had suffered from syphilitic irido-choroiditis and that his body bore marks of ulcerated syphilids.

As for the aortic lesion, it had affected neither the orifice of the aorta nor the aortic valves; auscultation revealed neither incompetence nor stenosis, and all signs of aortic insufficiency were lacking. Nor was there anything to lead us to suspect aortic ectasia. These various negative results caused me to think of a lesion called

supra-sigmoid aortitis. In this type of aortitis the syphilitic lesion is restricted to the first portion of the ascending aorta, forming thus a sort of segmental aortitis similar to segmental syphilitic arteritis.

A glance at the illustration (Fig. 1), in which the aorta is entirely thrown open, will give a satisfactory idea of the extent of this supra-sigmoid area above the three aortic leaflets and the orifices of the coronary arteries.

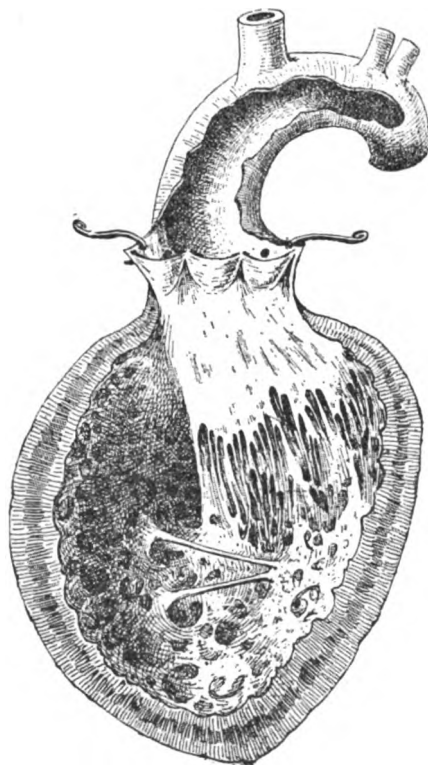


FIG. 1.—Aorta laid open.

One of the dangers of this supra-sigmoid aortitis is in that it borders so closely on the aortic orifice, sigmoid valves, and coronary arteries.

It is readily understood that such a lesion beginning in the aorta may easily extend downward a little to the sigmoid region, valves, and coronaries and thus create orificial lesion and coronaritis with all their disastrous results.

I therefore made in this patient with angina pectoris the diagnosis of supra-sigmoid syphilitic aortitis. That same day the patient received an injection of half a centigram of biniodide of mercury dissolved in water, and this injection was repeated on the following days; but the striking feature in this instance was that at the second injection the patient found himself in a state of comfort that he had not felt during his four years of illness. He told us that he had slept the previous night for a few hours in a manner that he had not experienced for years; that he breathed more freely; that he suffered less; and that he had a sensation as though he were coming back to life again.

A first series of twelve injections of half a centigram each was made; and then, after a pause, a second series of one centigram of biniodide at each injection; and lastly, after another interval, a third series of one and a-half centigrams per injection. After the second series our patient could even go upstairs without the slightest pain or oppression, his sleep was no longer disturbed, his appetite was rapacious and his terrible angina pectoris that held him at its mercy for four years was conquered at last. We saw the patient again a few months later and he had had no relapse.

This case suggests a few reflections. Surprise may be felt that a case of angina of four years' duration should be so rapidly ameliorated by the first injections of the mercurial salt! This is an occurrence that I have often observed and to which I always call attention in my lectures. A mercurial injection modifies both the syphilitic lesion and the symptoms caused by the lesion, but usually the symptoms disappear much more quickly than the lesion itself. Months are required to cure the lesion (in fact some of these lesions are incurable, as in the case of our first patient), whereas the symptoms are very rapidly controlled and even cured.

I wish to say also a few words about a third patient who came to our wards the 24th of last January. His expression denoted great suffering and terror; he had taken twenty minutes to walk from his home to the hospital, stopping any number of times. On reaching the ward he was seized with an attack before us, sank down on a bed, seemed to be suffocating, while atrocious pain was complained of in the precordium, neck, and arms. Two or three minutes after the first attack was over another began, and so on



for some time. When a series of attacks follow each other in this way they constitute a sort of anginal status comparable to what we know in epilepsy as the status epilepticus. When the attacks quieted down and we were able to auscultate the patient, we found a murmur at the base characteristic of aortic insufficiency.

We at once thought of a syphilitic lesion of the aorta, and ascertained that the patient had had syphilis. The aortic lesion and the attacks of angina had begun four years previously, suddenly and without warning. He had them at first a few times per month, then every week and finally every day.

In 1903 mercurial inunctions were prescribed for him together with potassium iodide, but as their treatment gave but slight results it was given up.

In 1905 the attacks of pain were so severe that the patient would roll on the floor when they occurred. Mercurial inunctions were then once more resumed and injections of heroin advised, whereupon the patient soon acquired the heroin habit, reaching as many as twenty injections a day, while his attacks of angina continued as before.

In January, 1906, at another hospital he was given a daily injection of two centigrams of benzoate of mercury; these injections were continued for six days, but at the fourth injection mercurial stomatitis set in.

The angina, which for a while had seemed to improve, then reappeared with its full severity, frequent attacks occurring day or night, and the patient developing ideas of suicide. It was in this condition that he came to our ward at the Hôtel-Dieu. I prescribed an injection every day of one centigram of mercury biniodide in water. After half a dozen injections there was noticeable improvement and the poor man was delighted; the anginal status had disappeared, the crises were less violent, and the patient got a certain amount of sleep at night.

Not long afterward a second series of injections of one and a-half centigram each was made, and the improvement increased; his crises then became quite tolerable, he was able to come to the hospital from his home without a stop, and could come up the stairs without difficulty.

After a certain interval a third series of injections was given. The patient who by this time had recovered the external appearance of a man in good health, reported that his attacks were now almost insignificant, that days would pass without his feeling anything amiss, and that he intended to resume his occupation as a locksmith.

These instances gave me an opportunity once more to refer to this excellent remedy, the biniodide of mercury. I know of no preparation of mercury to be compared to it. The amount to be prescribed varies from one half, to one, one and a-half, or two centigrams per injection and per diem, dissolved in water,—according to the case. It is seldom necessary to give larger doses than these. These injections should be given in series of ten or twelve, separated by fifteen to thirty days of rest. I have ceased to prescribe the iodide of potassium for many years now.

## RECENT PROGRESS IN THE DISORDERS OF THE ADRENALS

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UP to the last few years the pathology of the suprarenal bodies hardly comprised more than one single clinical unity, known as Addison's disease, from the name of the English physician who in 1855 first described the condition. This writer threw at the same time a little light on the functions of these organs, previously unknown, by demonstrating that their disorder, which is essentially characterized by melanoderma and by an invariably fatal termination, corresponded constantly with a destructive lesion of the adrenals. This lesion was at first considered to be peculiar to Addison's disease; but no great time elapsed before its tuberculous nature was recognized.

From that period on, this condition, known as Addison's disease, has always been admitted in pathology. But little by little two new factors were detected in the question; on the one hand, it was found that the adrenals could be diseased and remain latent without giving rise during life to the symptoms of Addison's disease, and, on the other, that cases of Addison's disease occurred in which no adrenal lesions were found postmortem. In some instances nothing but alterations of the abdominal sympathetic were discovered. In view of these facts, Addison's disease continued to be considered an autonomous condition, but its adrenal origin was contested and there was a tendency to incriminate the abdominal sympathetic system.

During a third period the researches of physiology have supplied a solution to this question. One of the functions of the adrenals was proved to be that of neutralizing the toxic products resulting from muscular work. Following this discovery it was observed that asthenia was one of the major symptoms of Addison's disease, and that this asthenia was correlative to the inadequacy of

the glandular function recently demonstrated. A second discovery of physiology demonstrated the existence of the secretion by the suprarenal capsules of a hypertensive substance, isolated ultimately by Takamine and called adrenalin. The knowledge of this function made possible the interpretation of another important clinical manifestation of adrenal lesions: arterial hypotension. These new ideas necessitated a revision of adrenal pathology, and at this moment Dieulafoy united under the rubric "imperfect forms of Addison's disease" all the clinical cases in which adrenal lesions had occurred without melanoderma.

Sergent and Léon Bernard next showed that it was more logical not to retain this single appellation in designating all the clinical forms of adrenal pathology, whose complexity was steadily increasing by these successive acquisitions, but that it was preferable, in the light of these confronting data of physiology and clinical medicine, to group together the phenomena depending on glandular insufficiency of these organs, and to distinguish them from those that do not depend on it, although observed when these organs are damaged. These writers then gave a clinical description of acute adrenal incompetency. Finally, more recently still, the researches of Josué and of Vaquez have made it possible to draw a preliminary outline of the chemical tableau corresponding, on the other hand, to functional superactivity of the adrenal bodies.

Consequently we are now in a position where we can write the physio-pathological history of these organs; we are able, as has previously been done in the case of the liver, the thyroid gland, and the kidneys, to separate natural groups of symptoms according to the functional disturbances that give rise to them. It follows from this that a knowledge of the normal functions of these organs is indispensable for the comprehension of these symptom-groups, and it will therefore not appear superfluous to describe them in a few words.

We have at the present time to consider as the adrenals three varieties of histological elements, to which correspond three distinct functions, and which are to be found in the different layers of these organs:

(1) The cells of the cortical substance contain different kinds of fatty bodies, of which one in particular has been much studied

and shown to belong to the chemical group of the lecithins. When through tetanizing an animal its muscular work is increased, a parallel increase in this special kind of fat in the cortical substance of the adrenals is observed; we have therefore to deal here with an actual secretion of this fat corresponding to the myotonic function. These experiments have also been verified by other observers. Consequently the adrenal function whereby these glands neutralize poisons of muscular origin has its seat in the cortical cells. These elements likewise secrete pigments, whose purpose is unknown, though it is certain that they have no connection whatever with the change in the color of the skin described by Addison.

(2) In the medullary substance are found other glandular cells whose affinity for chromium salts has led to their being named chromaffine cells. This reaction takes place in little granulations elaborated by the cellular protoplasm which are no other than the atoms of the adrenalin. Therefore, the second function of these organs, a hypertensive one due to the secretion of an active principle called adrenalin, is localized in special cells of the medullary substance.

(3) Finally, in the same medullary substance are to be found other elements, a distribution of nerve-cells. These belong to the sympathetic system, and it has been observed that the chromaffine cells and the sympathetic nerve-cells are invariably to be found together. We think it probable that these nerve-elements represent the anatomic organ whereby the adrenals intervene in the production of cutaneous pigmentation, which belongs to the functional domain of the abnormal sympathetic; but this is a hypothesis into which I purpose to enter in connection with the clinical cases, which furnish its most solid basis.

I shall not refer to the other functions that have been attributed to the adrenals—a glycosuric function, and an antitoxic one,—as their mechanism, and perhaps their very existence, have as yet been insufficiently elucidated.

To sum up, then, we are at present well acquainted with two functions of these organs of a glandular nature, their myotonic and their angiotonic functions; the pigment-function belongs to the sympathetic nervous system, and the adrenals are only concerned in it indirectly, and independently of their glandular functions.

The pathologic disturbances of these functions may occur in two contrary directions; here, as in all other glands, we observe either functional superactivity or functional inadequacy, hyperpinephry, or hypopinephry, terms proposed by Bernard and Bigart to designate the anatomic conditions of these organs noted during cases of experimental intoxication, and that seemed applicable to two contrary functional conditions of these glands. But, lesions of a similar nature have since been detected in man: lesions of hyperpinephry in atheroma, in interstitial nephritis, and in polycystic kidney; lesions of hypopinephry in the different forms of infections and toxic adrenalitis. The result is that, combining our clinical, physiologic, and anatomo-pathologic data, it is possible for us to fashion one symptom-group for hyperpinephry, and another for hypopinephry, from which we will distinguish Addison's symptom-group, characterized essentially by melanoderma, a symptom that does not form a part of the foregoing ones and that is not connected with the glandular functions of these organs.

**HYPEREPINEPHRY.**—This complex is the one that has most recently been discovered. When Josué had shown that repeated injections of adrenalin gave rise to atheromatous lesions of the aorta, Vaquez advanced the idea that atheroma, and different other allied clinical manifestations, must be due to the circulation throughout the system of an increased amount of adrenalin resulting from a condition of hyperpinephry. Of these manifestations arterial hypertension is the essential one, the others being mere derivatives; and Vaquez established a symptom-complex of arterial hypertension due to hyperpinephry. It comprises headache, different ear disturbances (vertigo, noises), ocular trouble (amaurosis, glaucoma), transitory aphasia, attacks of convulsive encephalopathy, transitory hemiplegia, and finally, cases of sudden death.

Vaquez described three clinical forms of his complex: transitory hypertension, noted during acute disorders, such as lead-colic or eclampsia; oscillating or unstable hypertension; and permanent hypertension, as seen in chronic disorders, such as interstitial nephritis or chronic lead poisoning.

This very interesting conception is based, therefore, on two hypotheses, whose probability has been clearly shown by Vaquez: the first consists in ascribing to arterial hypertension a series of

accidents which had heretofore been attributed to other causes; the second consists in falling back on hyperepinephry as an explanation for hypertension. It is necessary, however, to say that although the anatomic signs of this condition have been verified in a certain number of cases, the latter are not yet in sufficient number to warrant any generalizing; furthermore, even in these cases it has perhaps not been sufficiently proved that hypertension is the consequence of hyperepinephry, since other causes of hypertension may be coexistent at the same time.

With these qualifications it appears certain that hyperepinephry is sometimes the cause of arterial hypertension, which latter is the origin of other symptoms, of which the future will give us a more accurate and complete knowledge.

**HYPOEPINEPHRY.**—This symptom-complex, also called adrenal insufficiency, is better known at the present time; the only difference of opinion concerns the melanoderma, which in our judgment does not belong to this condition.

Its symptomatic elements are manifold, and answer to the inadequacy of the glandular functions of the adrenals. The mechanism of the majority of them is explained by the physiology of the glands; others are less easy to interpret, but clinical observation obliges us to unite them to the foregoing in the same natural group.

Asthenia is the essential symptom of this form, in which it assures an intensity that is quite special. In acute cases it is a massive, profound depression that simply lays the patient low in no time. In chronic cases it proceeds progressively; beginning by fatigue, it finally leads the patient to absolute immobility. Such patients first find that they grow tired more rapidly than customarily; then they are no longer able to fulfil the ordinary duties of their life; and finally they are confined to bed, dreading the slightest movement, incapable of any effort, and reduced to complete muscular inactivity.

Through its intensity and method of procedure this symptom is of the very highest value and importance; and it is explained by physiology, since it is in relation to the abolition of the myotonic function of the adrenals. Its diagnosis is easy when its evolution has been followed a certain time. Proposals have been made to confirm these clinical data by the use of Mosso's ergograph; but this

instrument appears to be subject to varying conditions which lay its results open to question.

Next to asthenia, arterial hypotension is the most important symptom of hypoepinephry, particularly when it is pronounced and occurs apart from any circumstance, cardiovascular or other, capable of explaining it when there is no adrenal insufficiency. This symptom is in relation to the loss of the other essential function of these organs, their angiotonic action. Tension is usually below 100 mm. of mercury, and in some instances falls to extremely low figures. This hypotension is the origin of circulatory disturbances that are rarely lacking: tachycardia, arrhythmia and a tendency to syncope and collapse.

Peripheral vaso-motor disorders are also part of the condition of hypoepinephry. They have been carefully studied by Sergent, who has made known how to detect them by means of the *adrenal linea alba*. This sign is to be sought for by drawing gently across the abdominal wall some blunt-pointed object; in thirty to sixty seconds the line thus made loses its color, and this pallor persists for several minutes in the form of a stripe wider than the object that gave rise to it by pressure. This phenomenon seems to be of great value, in spite of the negative assertions of LeClerc, who seems not to have distinguished it from another vaso-motor sign described by Gobler, and differing from this one clinically as well as pathogenetically. According to Sergent the mechanism of the adrenal linea alba is connected with the state of arterial hypotension; we have still to ascertain whether arterial hypotension, whatever may be its origin, always occasions this phenomenon, or whether it only appears in hypotension of adrenal origin.

Other nervous troubles still are observed during adrenal insufficiency. Forms of paralysis are rare, and only attack the respiratory muscles in the terminal phases of the symptom-complex. But Sergent has reported paralysis of the internal muscles of the eye, attributing it to the lack of adrenalin in circulation; on this theory mydriasis would belong to the group of symptoms of adrenal insufficiency. Disturbances of sensation take a more important part in the affair; diffuse and generalized hyperesthesia is often observed; in other cases, pain in the lumbar region or at the epigastrium radiating in various directions; sometimes atrocious abdominal



colic, especially in the acute forms of this complex. Epigastric and lumbar pains are more frequent in the chronic form, and very likely are not dependent on glandular inadequacy; they belong rather to the symptoms of sympathetic origin, and ought, perhaps, to be ranged in the Addison group; a close study in this connection of cases of slow and undoubted adrenal insufficiency will enable us, later on, to settle this point. Finally, brain symptoms occupy an important place, such as headache, delirium with agitation, convulsions when the patients are young, and coma, which is sometimes the final phase of adrenal insufficiency. These phenomena are perhaps the result of the general intoxication produced by this functional disorder.

Lastly, digestive disturbances are constant in hypopinephry, however obscure may seem their explanation; they consist in vomiting, persistent and repeated, usually accompanied by stubborn constipation; but in some instances there is diarrhea, particularly in children, occasionally very abundant, choleric form.

Such are the elements of the symptom-group hypopinephry as they now appear to us: asthenia, arterial hypotension, abdominal linea alba, and various nervous and digestive disturbances. In clinical medicine these symptoms make various combinations and follow a varying course. Three leading forms can be described:

(1) The acute form, first seen by Sergent and Bernard in a patient of twenty-four, who was suddenly seized, shortly after a mild attack of tonsillitis, with severe abdominal pain, profuse bilious vomiting and intense headache; the extremities soon grew cold, and this hypothermia was followed by cardiac collapse, which completed the depression and profound prostration of the patient, who died suddenly two days after the beginning of these symptoms. This patient presented the exact signs of a case of poisoning.

In other instances the clinical appearance is a little different: owing to the combination of emesis, abdominal pain, and tympanites, Ebstein has described a pseudo-peritonitic form of the disorder; Hecford a pseudo-choleric form, owing to the gravity of the digestive phenomena, together with the general signs of intoxication; Arnaud an adrenal apoplectic form, on account of its sudden appearance during adrenal hemorrhage; and finally, Sergent a pseudo-meningitic form, owing to the predominance and

particularity of certain nervous phenomena. But these are all varieties of one and the same symptom-group, that of acute adrenal insufficiency.

(2) Next to this form should be mentioned the subacute variety, in which the phenomena follow a course not of a few days, but of several weeks or months. I have elsewhere published cases of this category, and will now only recall a recent one observed with Heitz, of a woman of thirty-eight who died after remaining four months in a condition characterized by progressive asthenia, emesis with epigastric pain, and an arterial tension of 60 to 70 mm. of mercury. Post-mortem examination confirmed the adrenal origin of the disorder, recognized during life; there was found adrenal inflammation, whose histological characters showed hypoepinephry and a subacute process.

(3) Finally, in a somewhat artificial manner it is possible to separate a chronic form from the subacute ones. In these cases we have patients who appear to have Addison's disease, except that there is no melanoderma. This group comprises what Dieulafoy described as the partial forms of Addison's disease. In them, together with the signs of adrenal insufficiency, there are general symptoms,—such as anemia, loss of weight, fever and cachexia,—which are not connected with the adrenal condition and depend more likely, in my opinion, on the initial morbid cause, tuberculosis or other disease. It is particularly in the acute forms that is witnessed the most evident manifestation of hypoepinephry, and it was this acute form that enabled us first to describe the disorder.

In conclusion, there is another phenomena to be ascribed to hypoepinephry,—sudden death. Together with Sergeant we have maintained that this terminal accident is unquestionably due to adrenal insufficiency, and ought not to be explained by the mechanism of nervous reflex. Sudden death takes an important part in the semeiology of the adrenals; it may form the closing scene of each one of the preceding forms of hypoepinephry; it can also appear suddenly, without previous admonition, in persons enjoying perfect health, apparently, and whose adrenal lesions had hitherto remained latent. In such instances it might be considered as a fulminating variety of hypoepinephry.

**ADDISON'S DISEASE.**—This is the last adrenal complex to be considered. It is characterized essentially by melanoderma. This symptom, which forms the basis of Addison's description, consists in a special, dark pigmentation of the skin and mucous membranes. At the start, small spots are noticed on the uncovered portions (face, neck, forearms); then the pigmentation spreads, and finally the entire surface of the body becomes of a uniform bronze tint, in which are conspicuous certain darker spots, and blacker zones on regions exposed to the sun and to friction. On the other hand, we have seen the case of a girl with whom the pigmentation was general *except* on the exposed parts of the body, face and hands!

The mucous membranes are also affected by this pigmentation, and the characteristic purple-brown spots appear in the mouth, on the lips and eyelids, and in the vagina; the nails and the teeth may also be darkened. The diagnosis of the melanoderma of Addison's disease is easy when it is fully developed; in the early stages recourse can be had to a subterfuge that has been recommended, and that consists in making it appear artificially at a given point of the skin by the application of a blister.

The causation of this symptom has given rise to endless discussions: is it of adrenal or of sympathetic origin? In my opinion the latter interpretation is the correct one, and this opinion is based on three kinds of arguments. Clinical experience shows us that melanoderma only appears in chronic disorders of the adrenals, never when these are acute; this fact is comprehensible by means of the nervous theory, but remains obscure with the adrenal theory. Experimentation has been incapable of producing unquestioned melanoderma through destruction of the adrenals. Finally, pathologic anatomy shows that melanoderma may exist without the slightest adrenal lesion, when the abdominal sympathetic is diseased, of which there are five instances now known; conversely, when Addison's melanoderma exists with suprarenal lesions, there are also lesions in the solar ganglia.

We therefore consider that the melanoderma is produced by irritation of the abdominal sympathetic, and represents a solar symptom, and not an adrenal one. The sympathetic nerve no doubt gives rise to it through the intermediary of the special nerves that govern the activity of the chromoblasts in which the cutaneous pig-

ment is prepared. As for explaining in what manner a lesion of the adrenals may engender this symptom, this is easy if we bear in mind the existence in the medullary substance of these organs of nerve cells connected with the sympathetic. According to Alezais and Arnaud, other such cells exist in the peri-adrenal cellular tissue. These cells are the intermediary between the adrenals and the sympathetic; whether some alteration appears in them, or directly in the sympathetic, the consecutive functional disorder is the same—melanoderma—provided this alteration has a slow evolution.

Melanoderma is the essential phenomenon in Addison's disease. It is possible that certain painful and digestive symptoms are also of a sympathetic origin. However this may be, the melanoderma can either be the sole sign present, or it can associate itself with other manifestations. When alone, it constitutes what has been termed the melanodermic form of Addison's disease, and this is the slowest form; cases are on record in which this melanoderma has lasted for twenty years without the appearance of any other phenomenon.

But the melanoderma may be combined with other manifestations. Some depend on the morbid cause itself: these are the general symptoms of Addison's disease: fever, anemia, loss of flesh, urinary disorder, cachexia. Others are signs of adrenal incompetency; and the classical forms of Addison's disease, which complete their evolution in from two to four years, are complex conditions made up of melanoderma, of signs of adrenal inadequacy, and of symptoms of general infection. The signs of adrenal inadequacy are sometimes the earliest to appear, the melanoderma only occurring at a later period; in other cases the contrary takes place, and we see the chronic complex of hypoepinephry adding itself to the sympathetic complex. Finally, let us remark that acute hypoepinephry may be the closing scene in Addison's complex, as may also the occurrence of sudden death.

To sum up, then, it may be said that what is known as Addison's complex, always a chronic disorder, comprises the following symptomatic elements: First, melanoderma, and perhaps some other painful and digestive phenomena, which constitute the sympathetic complex; second, the complex of adrenal incompetency in its chronic form, and, as a complication, the complex of acute, or

fulminating, hypoepinephry; third, general symptoms dependent on the causal disease.

Such are the different adrenal symptom-groups; but this outline that I have drawn of them, although comprising the knowledge that we now possess, will be no doubt further modified with time.

To complete the study of the pathology of the adrenals it would be necessary to indicate the distribution of these symptom-groups among the different disorders with which this pathology is concerned: inflammation of the adrenals, tumors, syphilis, and tuberculosis. This will form the subject of another publication.

# Surgery

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## THE PRINCIPLES OF TREATMENT OF FRACTURES OF THE LOWER EXTREMITY

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THE lower extremity is less subject to fracture than the upper, as represented by the figures 64 to 36. In other words, the upper extremity is fractured 64 times in one hundred cases, the lower 36 times. These figures are based on the study of 2,500 cases, occurring in the German Hospital, reported by Wilbert and myself. The percentage of frequency will be very nearly represented by the following table of the last thousand cases reported for both extremities:

	Per cent.		Per cent.		Per cent.
Hand .....	13.1	Humerus .....	1.2	Knee .....	6.4
Wrist .....	23.8	Shoulder .....	9.3	Leg .....	3.9
Forearm .....	5.0	Hip .....	2.1	Ankle .....	14.6
Elbow .....	11.8	Thigh .....	0.8	Foot .....	8.0

These figures will not hold good for all communities, because the occupation of class in different surroundings affects fracture statistics. They will, however, represent about the average for urban populations. Fracture of the femur alone, or associated with fracture of the pelvis at the hip joint, or with the patella or tibia at the knee, occurred 110 times among 2,500 fractures of the extremities (4.3 per cent.).

The blood supply to the head of the femur is largely through the vessels of the periosteum, hence the amount of the periosteum torn will govern directly the outcome of the fracture. In fractures of the base of the neck of the femur there is not the same loss of

blood supply, as the periosteum is not so extensively torn as in fracture of the thin portion of the neck, and even here there is frequently enough blood supply left to maintain the vitality of the smaller fragment. Impaction also favors the prognosis as to union, since the blood supply is not so seriously interfered with.

*Fracture of the hip*, one of the most distressing of all fractures, occurring as it does in the aged and most frequently in women, occurs in 2.1 per cent. of the cases, as against 8 per cent. for other portions of the femur.

*Fracture of the head of the femur* is very rare, the only known cases occurring with backward dislocation. The injury necessary to produce this condition is a crushing force.

In *fracture of the neck of the femur*, commonly called fracture of the hip, the line of fracture is either through the thinnest portion near the head of the bone (Figs. 1 and 2), or at its base, close to the line of the great trochanter (Figs. 3 and 4). The symptoms and treatment are the same in both. The prognosis, however, is governed by the condition of the periosteum and the blood supply to the separated head.

There is ample evidence at hand to prove that bony union occurs in many if not most hip fractures. There are considerations, however, that make it of doubtful utility to subject the patient to mechanical treatment. Old people stand confinement to bed very badly and many will die long before bony union occurs. In those of advanced age, in whom arteriosclerosis is manifest, treatment should not be persevered in unless the patient's general condition warrants it. In some cases it is folly to attempt treatment; the patient should be allowed to move about in bed or lie in the most comfortable position.

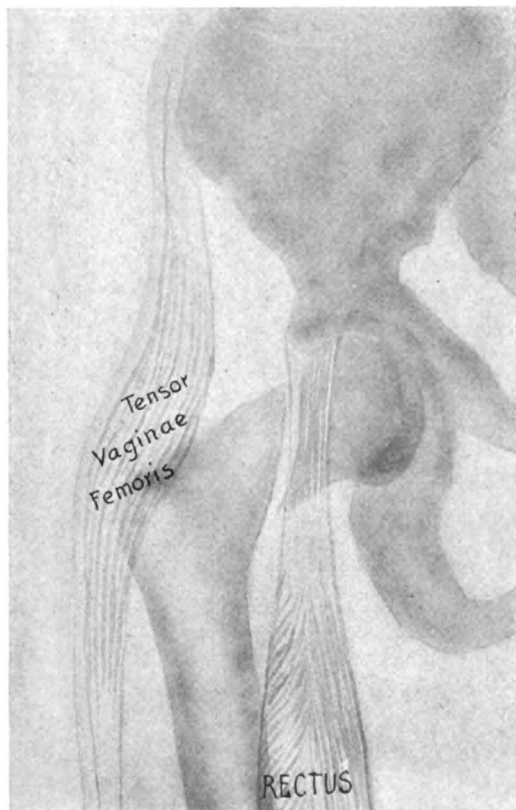
Hip fracture occurs, as a rule, from minor degrees of traumatism; tripping while walking on a level surface, falling on the hip, or simply a wrench in the attempt to recover the balance is sufficient to cause the fracture. Some cases occur before the patient falls, the fall being due to the break and not the break to the fall. The increased proportion of inorganic matter in the bones of the aged favor the accident.

The symptoms are eversion, pain, shortening, loss of function, and crepitus. Pain and crepitus need no special explanation.



**FIG. 1.**—Fracture through the narrow portion of the neck of the femur.  
(Same as **Fig. 2.**)





**FIG. 2.—Fracture through the narrow portion of the neck of the femur. (Same as Fig. 1.)**



**FIG. 3.—Fracture through the base of the neck of the femur. (Same as Fig. 4.)**

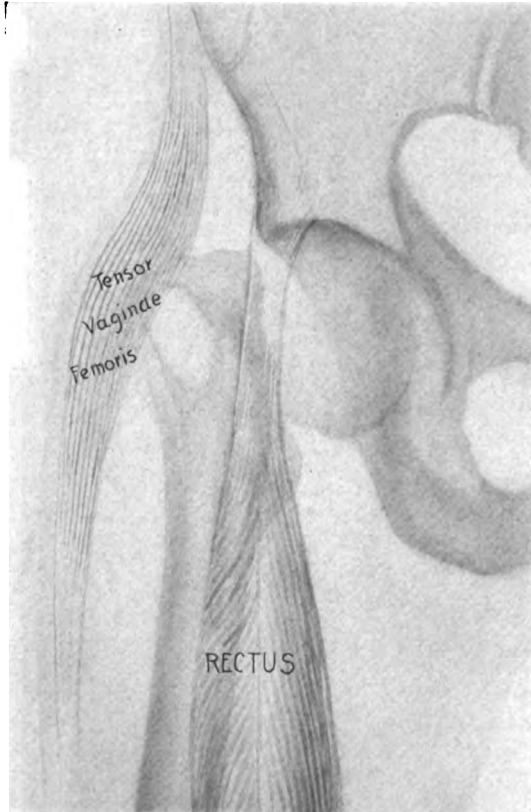


FIG. 4.—Fracture through the base of the neck of the femur.  
(Same as Fig. 3.)

The eversion is an exaggeration of the normal tendency of the limb to rotate outward and is purely mechanical. It differs in degree, and may be so pronounced that the outer side of the foot will lie flat on the bed. On the other hand, it may be so slight as to be demonstrable only when the patient attempts to invert both feet, when the difference will be noticed.

The shortening is due to the alteration of the angle between the shaft and the neck, or to overriding of the lower fragment. The degree varies from a fraction of an inch to two or three inches. Shortening does not always make its appearance immediately after the injury, but may be delayed for days, coming on gradually.

The usual method of measuring the limb is to take the distance between two bony points, the anterior superior spine of the ilium and the tip of the internal malleolus. This measurement compared to the sound limb will give an approximate idea of the shortening. The limbs must be in the same plane of abduction and rotation and in full extension. Bryant's triangle and Nelaton's line are methods of ascertaining the degree of shortening with more or less accuracy. The same practical result can be obtained by placing the thumbs on the anterior superior spine and the tip of a finger on each trochanter, the shortening of the injured side being thus estimated. Dr. Allis has pointed out the fact that the fascia lata between the crest of the ilium and the great trochanter, and also just above the knee, is relaxed on the injured side. A broadening and thickening of the upper portion of the thigh is a valuable sign readily recognized by the experienced eye.

The loss of function is complete and immediate. The patient cannot bear his weight on the limb and is even unable to move in bed. Any exceptions to this rule are probably cases of impaction.

Hip fracture being most common in the aged and decrepit is attended by the highest mortality of all fractures of the extremity. Some patients die of sharp inflammatory reaction, with fever and delirium. Pneumonia is common. Others are overwhelmed by the mental and physical shock. Still another class die of asthenia, with asthenic pneumonia or hypostatic congestion of the lungs. The older the patient, the more unfavorable the prognosis both as to life and function of the limb.

I know of a remarkable case in a lady of my acquaintance who

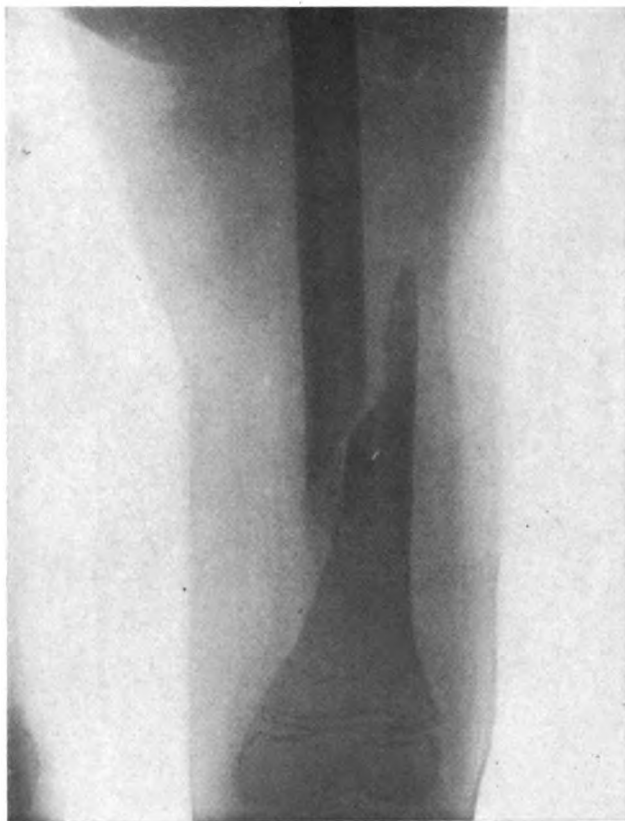
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broke her hip at the age of 102 years. She recovered with bony union and lived to be 106. The function of the limb was sufficiently restored to allow her to walk with comparative ease.

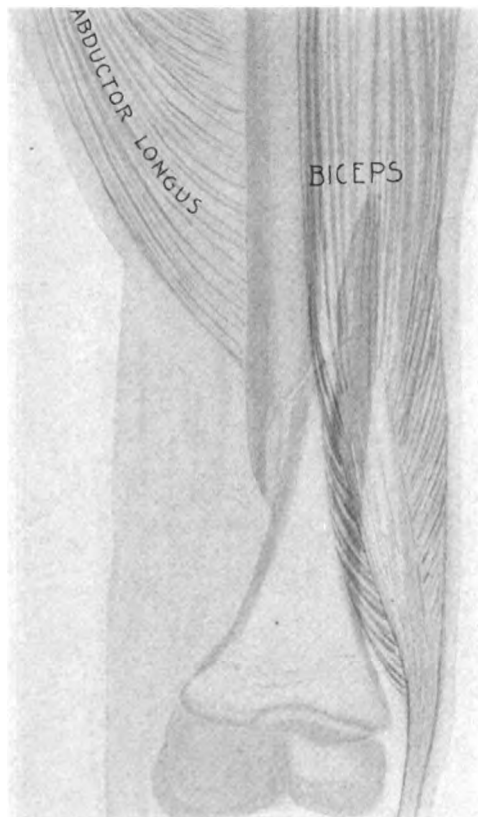
Bony union is quite as desirable in hip fracture as elsewhere. It occurs with sufficient frequency to warrant treatment to that end. There are, however, more important considerations than bony union. Rarely is there bony union with restoration of normal function. The fracture invariably heals with shortening and eversion. Hence, attempts at reduction and retention of the fragments in their normal condition are frequently ill-advised and invariably unsuccessful. Attempts at reduction may break up a mild degree of impaction and result in greater shortening and eversion; an untorn portion of the periosteum may be ruptured and the all-important blood supply to the upper fragment be destroyed. The age of the patient and the condition of his heart, kidneys, lungs, blood-vessels, and general resistance are to be carefully weighed. If he be young and strong enough an operation for fixing the fractured ends may be considered. In a robust person of advanced years, my practice is to prevent increase of the eversion rather than to attempt to correct that which already exists. This can be accomplished, in the majority of cases, by rest in bed with lateral support to the outer side of the limb, extending from the waist line to below the sole of the foot; sand bags, wooden splints, or pillows will answer the purpose. Continuous traction should be tried and if well borne and comforting to the patient, by reason of the elimination of the muscular spasm afforded, should be continued. It will have completed its usefulness in two or three weeks. The most simple and satisfactory method is Buck's extension. By slightly elevating the foot of the bed the tendency of the patient to slide to the foot of the bed will be overcome. The amount of the weight should vary from five to twenty pounds, according to the strength of the individual's muscles. The younger and stronger the patient, the greater should be the weight.

Lateral pressure on the great trochanter is useful in fracture through the narrow portion of the neck. This can be best accomplished by a pelvic band with a pad over the outer aspect of the great trochanter.

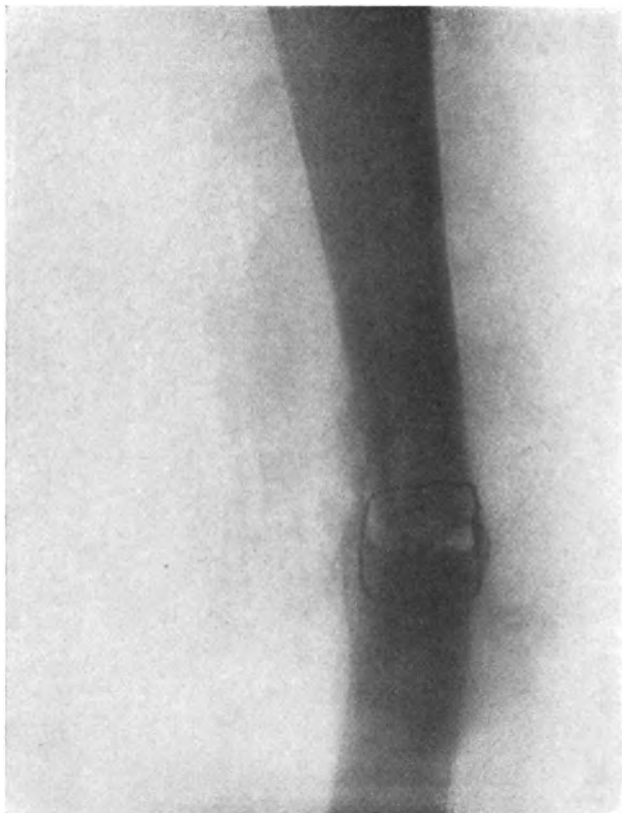
*Fracture of the great trochanter associated with fracture of the*



**FIG. 5.**—Spiral fracture of the lower end of the femur. (Same as Fig. 6.)

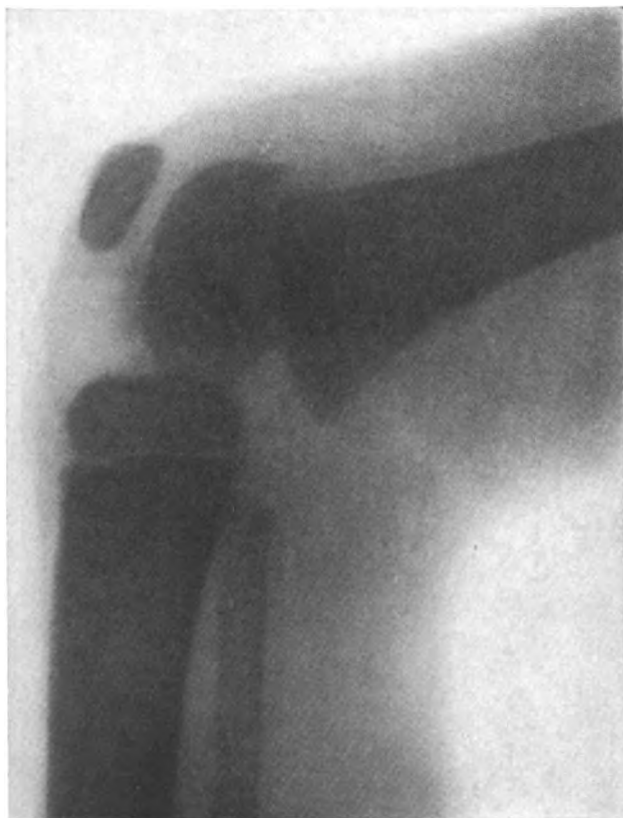


**FIG. 6.**—Spiral fracture of the lower end of the femur. (Same as Fig. 5.)



**FIG. 7.**—Transverse fracture of the shaft of the femur. Good position obtained by wiring the fragments.





**FIG. 8.—Epiphyseal fracture of the lower end of the femur.**

neck of the femur occurs occasionally. Fracture of the great trochanter is not of common occurrence. It occurs most often in young subjects and is due to direct violence. The line of fracture is in the epiphyseal line. These cases are probably true epiphyseal or pathologic fractures, osteomyelitis being the underlying cause. The symptoms are pain, tenderness and mobility. The patient is usually able to walk. Pain is increased by rotation of the hip. Immobilization with the limb in abduction and rotated outward, to overcome the pull of the muscles attached to the great trochanter, is the proper treatment.

*Fractures of the shaft* occur anywhere along its length, the middle third being the most common site. They may be caused by direct or indirect violence or muscular action. The line of fracture is usually oblique (Figs. 5 and 6), rarely transverse (Fig. 7) except in children. The displacement of the fragment is excessive and the deformity of the limb very marked. This is due to the great force necessary to cause the fracture and to the pull of the powerful extensor and flexor muscles of the thigh. The swelling beneath the deep fascia of the thigh causes the limb to broaden and shorten. The lower fragment is pulled upward and backward and at times is rotated outward. Angular deformity is usually marked. In fracture of the upper third the action of the psoas and iliacus and the gluteal muscles cause the upper fragment to be displaced forward and outward, giving rise to marked angular deformity. This is enhanced by the action of the flexors and abductors on the lower fragment, drawing it up to the displaced upper fragment.

*Fractures of the lower third* are more commonly compound, due to the obliquity of the line of fracture and to the fact that the knee is usually flexed when the breaking force is applied. The sharp lower end of the upper fragment is forced through the quadriceps extensor muscles and the skin. In order to disentangle the upper fragment, the knee must be flexed before manipulation is begun. The symptoms of fracture of the shaft of the femur are pain, loss of function, deformity, mobility where it is normally absent, and shortening. Shortening is of first importance in the diagnosis of the injury. It is demonstrated by measuring both extremities and making the comparison. To be accurate both

limbs must form the same angle with the pelvis, and the measurements must be made between two fixed bony points, the anterior superior spine of the ilium and the tip of the internal malleolus. Place a measuring tape so that it will touch the most prominent point of both iliac spines; from its center drop another tape to the ankles. Bring both limbs in the same plane to this central tape. The angle of the limbs to the pelvis will now be the same and the distance from the anterior spines to the malleolus will be relatively correct. The shortening may vary from a fraction of an inch to several inches. Deformity may not be easily recognized by the eye or the hand as the femur is enveloped in so much soft tissue that it may be undemonstrable. The unnatural mobility and crepitus can be recognized by placing the hand under the suspected locality of the break and gently lifting the limb; by holding the upper fragment and gently rotating the limb; or by noting whether the great trochanter moves when the leg is rotated. All these manipulations must be carried out with the greatest gentleness, as rough handling may do irreparable damage.

Fracture of the shaft of the femur is a serious injury and a difficult one to treat. It rarely heals without some permanent shortening. The period of confinement to bed is from three to six weeks and is followed by several weeks of partial disability when the patient must go about on crutches. There is frequently a permanent limp. The immediate danger, especially in old age or in depraved conditions, is from traumatic delirium and death. There is danger of gangrene by injury to the great blood vessels of the limb and from the pressure on them by unreduced fragments. The muscular atrophy from long non-use is difficult to overcome, and the passive edema which comes on after the limb is released from the supporting dressing is slow to respond to treatment.

Strong extension and counter-extension with lateral support to overcome outward rotation is the principle of treatment. Buck's extension offers the most satisfactory way of accomplishing the extension. Elevation of the foot of the bed gives counterextension by the pull of the body weight. Lateral support can be supplied by a long outer sand bag extending from the axilla to beyond the sole of the foot, a shorter one being placed along the inner side of the limb from the perineum to beyond the sole of the foot.

— Long board splints applied in the same position as the sand bags can be used; they should be retained in place by bandages and adhesive plaster. Hodgen's suspended splint, by which the limb is swung clear of the bed, is comfortable, but does not offer the same degree of immobilization of the fragments. The same objection holds good with regard to the double inclined plane.

Buck's extension should be used as follows: The side strip should be from  $1\frac{1}{2}$  inches to 3 inches broad, according to the size of the leg of the patient; it should be extended from just below the head of the tibia to three inches below the sole of the foot. Some authorities advise extending the plaster above the knee as far as the seat of the fraction. Zinc oxide plaster is least irritating to the skin. The board, pierced in the center for the passage of the weight rope, should be the same width as the plaster and long enough to prevent contact of the plaster with the malleoli. The weight should be sufficient to overcome the powerful thigh muscles, 5 to 25 pounds. The weight rope must run over a pulley so that it will give to the slight motion of the body without releasing its pull.

A pledget of cotton must be placed under the tendo Achillis, so as to remove all pressure from the heel. When the side strips are properly placed a few inch-wide circular bands will serve to prevent their slipping. They should not, however, completely surround the leg and thus endanger the return circulation. If at the end of two, three, or four weeks union has progressed satisfactorily, a plaster cast can be applied to the limb and the patient taken from bed and placed on a rolling chair. This is desirable when feasible, to promote the patient's comfort and allow a change of scene and air. This dressing must include the pelvis and extend to the ankle and include the foot. It is necessarily very heavy and cumbersome, but in the later stages of repair, when the patient is strong enough to use crutches and support the extra weight, is of use. I would not advise its use before the fourth or fifth week.

A not uncommon *fracture of the lower end of the femur* (Fig. 8) is intercondyloid or T fracture, in which both condyles are separated from the shaft and a fracture, in the long axis of the shaft, separates the two condyles from each other. The way in which the fracture occurs is probably a transverse or oblique fracture, breaking

off both condyles in one piece, the lower fragment then being driven into the upper fragment, which acts as a wedge, splitting the fragment into two pieces. This fracture is frequently compound. The popliteal vessels may be torn by the upper fragments or dangerous pressure exerted by the fragments on the vessels, causing death by hemorrhage or gangrene of the leg.

The prognosis is serious both to the life of the patient and to the restoration of the joint. Traumatic arthritis followed by suppurative resulting in stiffness or requiring amputation is likely to occur.

In the absence of injury to the blood vessels which may require immediate amputation, the best treatment is to place the limb in a plaster cast, extending from the foot to midway up the thigh.

*Fracture of either condyle* occurs occasionally, due usually to direct violence, as a fall on the bent knee, or to indirect violence, extending through one lateral ligament, causing the condyle to be nipped off by avulsion, or to direct pressure of the tibia on one condyle while the leg is bent in the opposite direction.

The symptoms are localized pain and ecchymosis, loss of function of the knee and abnormal mobility. Delayed union and non-union are common in this injury. Suppuration may intervene, requiring removal of the detached fragments.

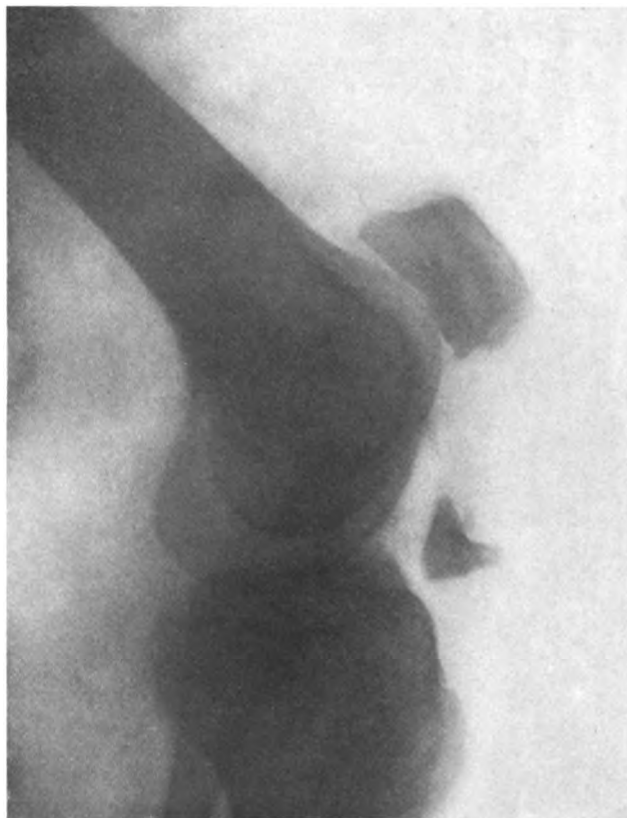
The treatment consists in placing the limb in plaster in full extension. Ankylosis is not due to position but to traumatic arthritis. Prolonged rest is essential, followed by persistent massage and passive motion.

*Fracture of the patella* occurs as a result of direct or indirect violence or muscular action. In a series of 2,500 cases<sup>1</sup> it occurred 47 times, twice associated with fracture of the tibia. (Figs. 9 to 15.)

The usual accident causing the injury is forcible contraction of the quadriceps extensor muscle, as in an attempt to recover the balance when thrown forward by catching the toe on some obstacle, by forced flexion of the knee when the muscle is strongly contracted in opposition. Direct violence is rarely applied to the patella by falling on it, as in full flexion the patella is pulled upward, the

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<sup>1</sup> Ross and Wilbert, Phila. Med. Jour., 1899, 1900, and 1902, and American Medicine, 1904.



**FIG. 9.—Fracture of the patella. Wide separation of the fragments. (Same as Fig. 10.)**

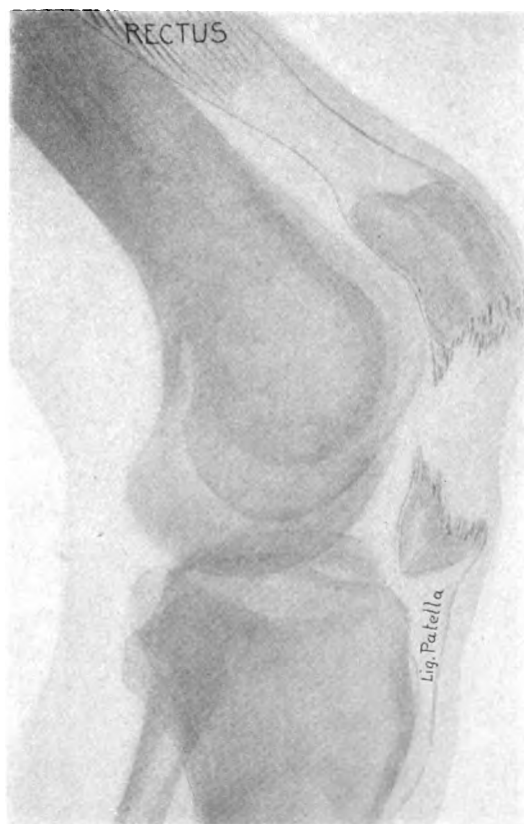
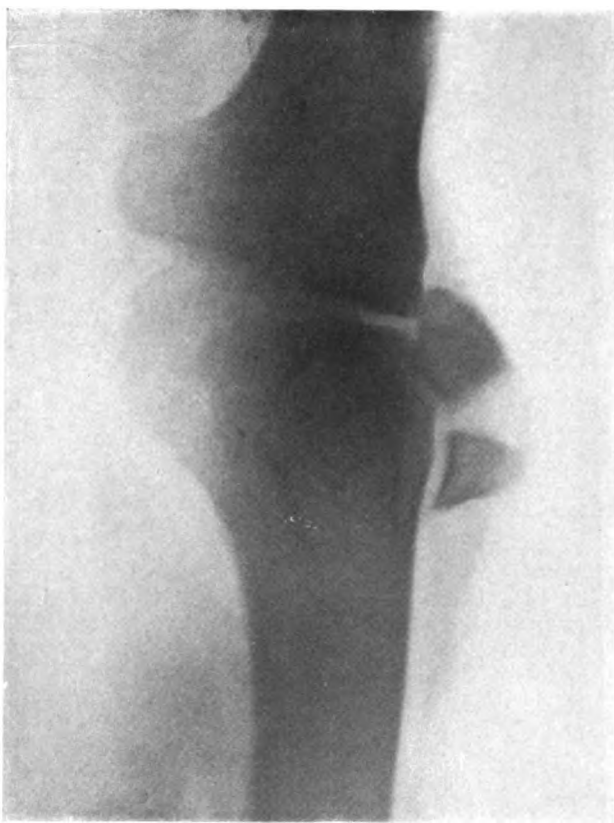
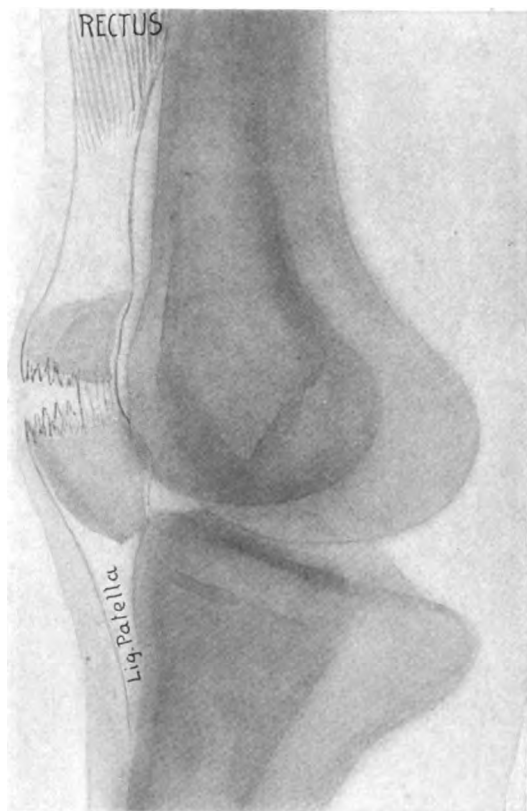


FIG. 10.—Fracture of the patella: wide separation of the fragments, complete rupture of the capsule and ligaments. (Same as Fig. 9.)

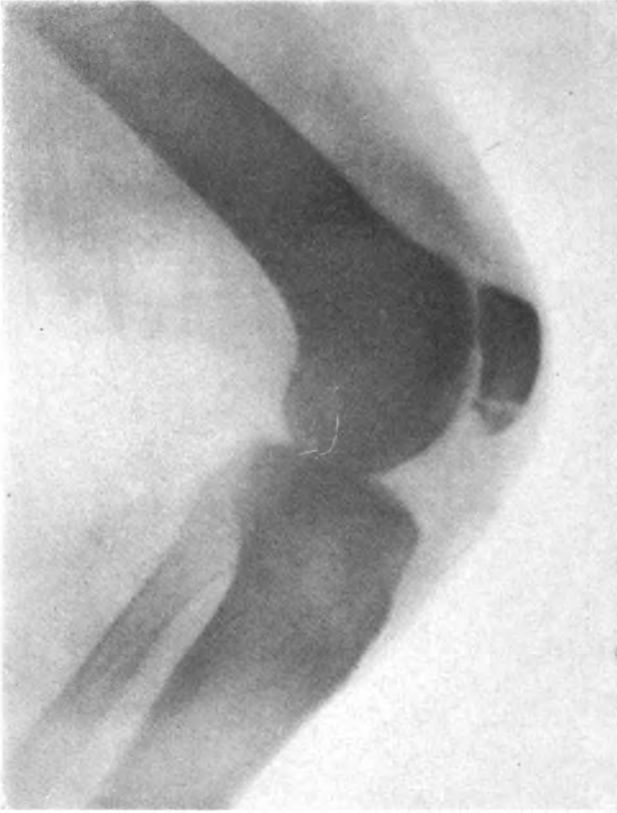


**FIG. 11.**—Fracture of the patella ; very moderate separation of the fragments. (Same as Fig. 12.)

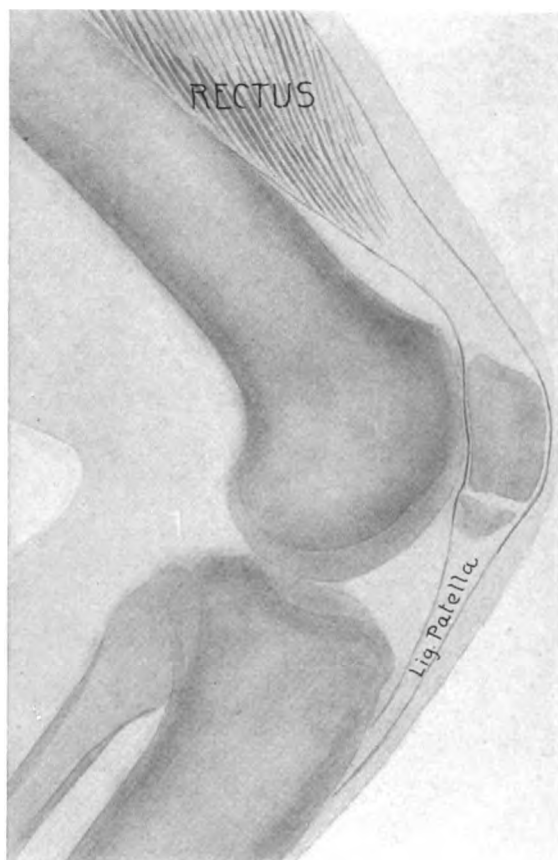




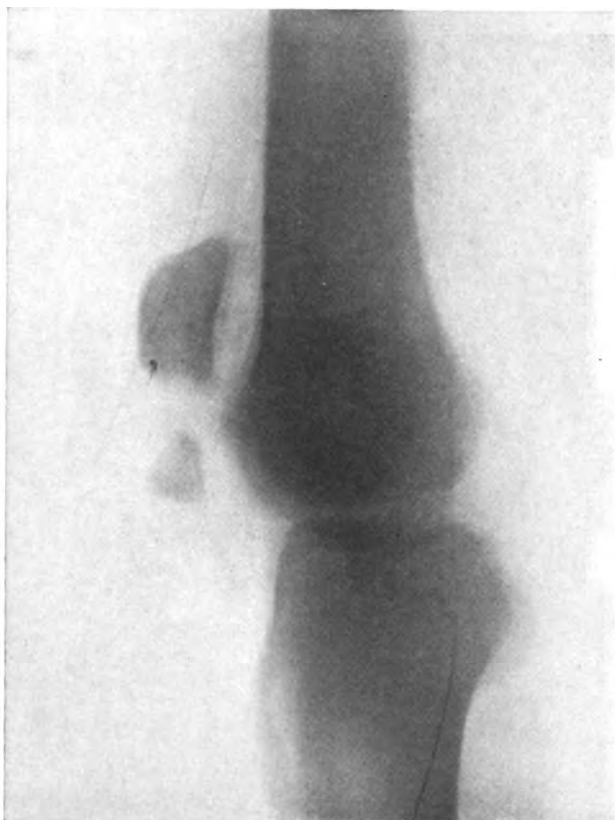
**FIG. 12.—Fracture of the patella; very moderate separation of the fragments; part of the capsule intact. (Same as Fig. 11.)**



**FIG. 13.**—Complete bony fracture of the patella without displacement.  
(Same as Fig. 14.)



**FIG. 14.**—Complete bony fracture of the patella without displacement; the capsule and ligaments intact. Same as Fig. 13.)



**FIG. 15.—Fracture of the patella with moderate separation. Shows tilting forward of the lower fragment.**



**FIG. 16.—Fracture of the patella; bony union in perfect condition, the result of wiring the fragments. The wire is broken.**



**FIG. 17.**—Another case of good result in fracture of the patella by wiring.



**FIG. 18.**—Sesamoid bone in the hamstring tendon, not to be mistaken for a sprained fracture of the condyle.

force being in this position applied to the prepatellar bursa and the tuberosity of the tibia.

The patella must be struck by some implement, the force being applied directly to the bone. The fractures of the patella due to direct violence are likely to be comminuted.

The line of fracture is usually transverse, with sharp cut edges. Its most frequent location is through the middle or below it.

The degree of displacement depends on the amount of the injury or tearing of the fibro-periosteal envelope of the bone and the expansion of the lateral ligaments of the knee and the capsule on the sides, and the fascial expansion downward. The capsule is usually torn transversely and not in the same place as the bone fracture, thereby allowing the torn edge to drop down between the fragments, and preventing close coaption and bony union. The diagnosis is easy if there be a wide separation of the fragments. If there is a fracture without separation the diagnosis is difficult and may only be made clear by the x-rays.

The patient as a rule is conscious of the injury as he hears the sharp snap of the bone breaking. He is unable to walk forward as he cannot extend the limb. Pain is moderate and is increased by attempts at extension or by manipulation. The swelling is due to hemorrhage, effusion of synovial fluid, and tumefaction of the soft parts. Mobility and crepitus can be demonstrated when there is some separation of the fragments. When there is no separation the diagnosis is made probable by the history of sufficient force to produce the injury, by localized tenderness and pain and the rapid swelling. In this class of injury placing the limb at rest in full extension, preferably by a plaster cast, is all that is needed. It should be in this position for four or five weeks.

When the soft parts are torn and the fragments separated, the only logical surgical treatment is open operation with suture of the soft parts, and in exceptional cases fixing the bone fragments by means of silver wire or kangaroo tendon. The strength of the healed patella depends more on the restoration of the capsule and extension of the lateral ligaments than on the union of the bone, although bony union is most desirable and an added security against refracture. The operation should not be attempted except by experienced hands and under most rigid rules of asepsis.



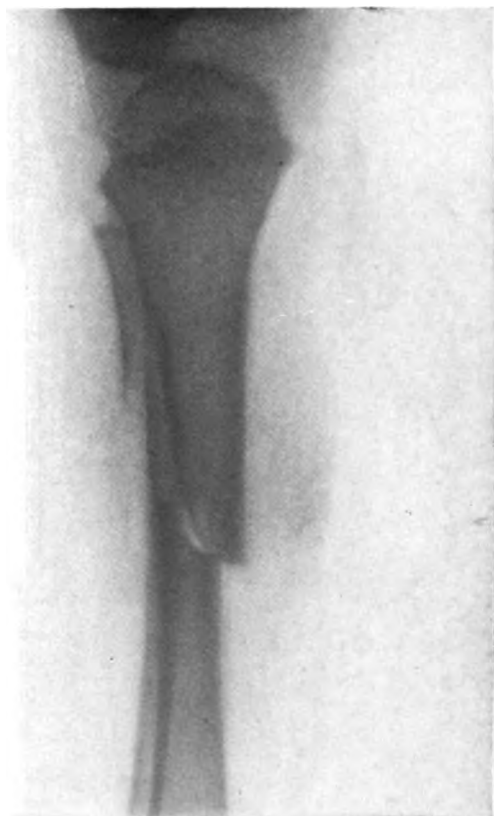
Infection of the knee joint is always disastrous, endangering life and limb. The effusion into the joint, the result of the traumatism, offers an ideal culture medium, and the resistance to infection in the knee is a minimum quantity. Therefore it is well to wait for a week or ten days before operating. If operation is decided upon the method is as follows:

Clean the field of operation by a liberal use of soap, water and brush several times repeated. The brush should not be stiff and should not be used too vigorously, else the skin will be irritated. Wash with alcohol 95 per cent., followed by bichloride of mercury (1 to 1,000) and finally with normal salt solution or sterile water. Use sterile rubber gloves on the hands of every one of the operating staff, assistants and nurses.

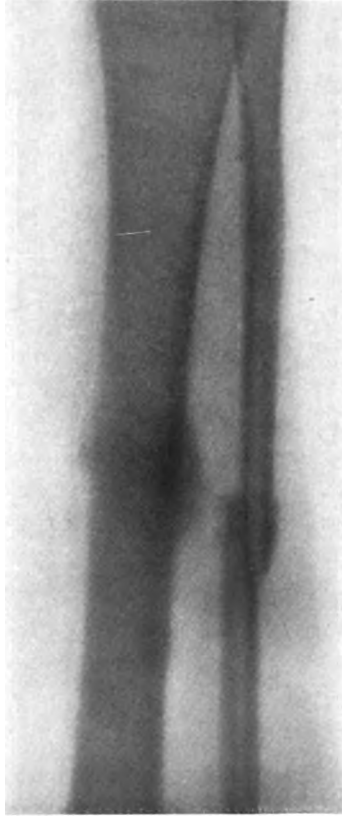
The U-shaped incision offers the most room for manipulation. The longitudinal, if long enough and well retracted, will answer the same purpose. After going through the superficial fascia the joint will be exposed through the aperture between the fragments. Remove all clots of blood and debris. Approximate the broken edges of the patella and trim away all the intervening edges of periosteum and capsule. It is well gently to freshen the edges of the bone with the curette. With a chromic catgut suture, sew the torn edges of the lateral ligaments and their extensions to the patellar capsule. Sew the periosteum and capsule over the fragments. As a rule this will bring the edges of the bone together and hold them. It is rarely necessary to bore holes in the fragments for the passage of silver wire or tendon, as the above described sutures will suffice. Close the wound without drainage. Place a large absorbent dressing and over all a plaster cast, extending from below the calf muscle to 5 or 6 inches above the knee. Elevate the limb so as to relax all pull of the quadriceps extensor muscles. (Figs. 16 and 17.)

The limb should be kept at rest in the cast for 5 or 6 weeks, after which massage and passive motion should be instituted and persisted in for weeks. The patient will not be confined to bed after the third week if the cast is unbroken, but should be allowed to go about in a rolling chair with the leg extended, or to walk with the aid of crutches.

In the series of 2,500 cases alluded to in this paper, fracture of



**FIG. 19 —Oblique fracture of the tibia and the fibula—upper third.**



**FIG. 20.—Fracture of both bones of the leg about the middle.**

the bones of the leg exclusive of the malleoli occurred 140 times or 5.6 per cent. The location of the fractures was as follows:

Upper third of the tibia, 22; upper third of the tibia and fibula, 6; middle and lower third of the tibia, 44; both tibia and fibula, 64; and fibula, 24. Fracture of the upper third is least common of all fractures of the leg bones. The middle third is the most common location and the lower third next in order.

Fracture of the upper third occurs as a result of either direct or indirect violence. A horse kick on the leg or the falling of some heavy body, such as a horse, is a common cause. A fall with the limb in abduction is a good illustration of an indirect violence. Associated fracture of the internal condyle of the femur is a common occurrence, as the line of indirect force is through the head of the tibia and internal condyle. The line of the fracture may be transverse, oblique or longitudinal.

In transverse fracture the line of fracture is usually close to the articular surface. The oblique fracture involves one or both of the expanded articulating surfaces of the tibia, while the longitudinal occurs between the articulating expansions, usually entering the joint. Fracture of the upper extremity of the tibia is frequently comminuted—in which case the longitudinal and oblique line of fracture are both present. Fracture of the upper end of the fibula, associated with that of the tibia, does not offer a serious complication. Fracture of the upper end of the fibula alone occurs as a result of direct violence, such as a horse kick or blow. It is easily recognized by the local tenderness, swelling and crepitus. A plaster cast for three or four weeks is sufficient to correct the injury.

The diagnosis of fracture of both bones of the leg high up (Figs. 19 and 20) is difficult and uncertain. An anesthetic should be administered so that a correct estimation of the line of fracture and the exact position of the fragments can be made. The necessary manipulation for the reduction of the fracture and the application of the dressing can be completed before the patient regains consciousness.

The prognosis of this fracture is not good, as it is so near the knee joint and so frequently disturbs the mechanical relations of the joint surfaces that it is rare for function to be restored. The

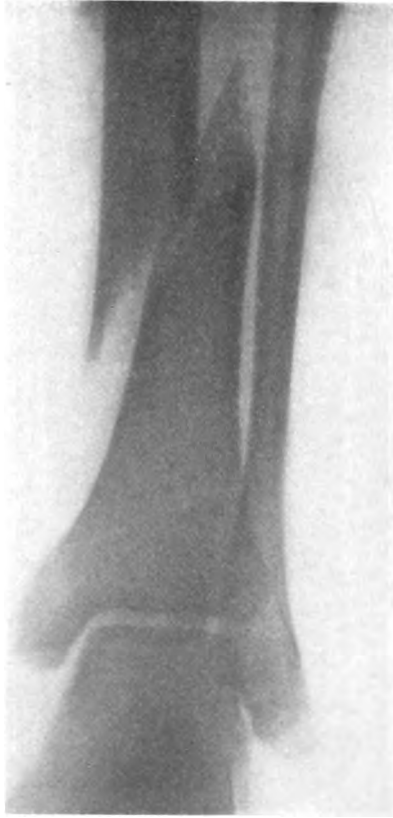
period necessary for repair is much longer than for other fractures of the tibia or in fact of any of the bones entering into the formation of the knee joint. The average time given by Poncet, who collected seven cases, was four months.

Inflammatory action may be so great that suppuration of the joint may intervene.

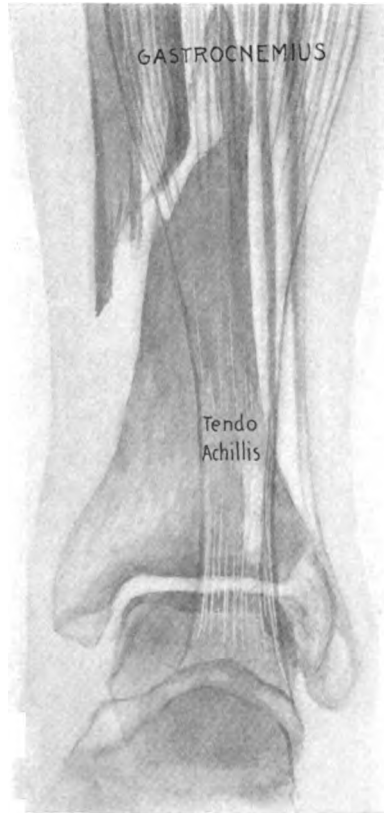
There is no rule for manipulation for this fracture. One must act according to circumstances, using extension or counter-extension with direct pressure on the fragments. The plaster cast is the best form of fixed dressing.

A tearing loose of the tubercle of the tibia occurs occasionally. It is produced by violent action of the quadriceps extensor muscles pulling on the patellar tendon. It is most common in youths, as the tubercle is not strongly united to the shaft until full adult growth is attained. I have seen one case in an aged colored man, in which the patellar tendon was completely severed, giving rise to the wrong impression that the lower segment of the patella was fractured. The injury was repaired by sewing the torn tendon, and resulted in perfect restoration of function. The treatment of avulsion of the tibial tubercle is to press it into place and so retain it by strips of adhesive plaster. The limb should be placed on a posterior splint in full extension. Four or five weeks is the time required for healing.

*Fracture of the leg* is most common at the junction of the middle and lower third. The explanation lies in the fact that when the violence is indirect the force is a twisting one, the foot being more or less fixed on the ground while the forcible contraction of the powerful muscles is spent on the upper portion, propelling it forward. When due to direct violence, the individual lying on the ground, the bow of the limb due to the prominence of the os calcis or the malleoli, favors the fracture at this point. The line of the fracture may be oblique, spiral or transverse. I have found that transverse fractures (Fig. 20) are more common than many authorities state. Both bones are usually involved, although the fracture of the fibula is as a rule not on the same level with that of the tibia, being higher. Deformity is usually marked, the lower end of the upper fragment being displaced forward (Figs. 21 and 22) as the powerful muscles on the back of the leg pull the lower



**FIG. 21.—Oblique fracture of the tibia. (Same as Fig. 22.)**



**FIG. 22.—Oblique fracture of the tibia. (Same as Fig. 21.)**

fragment backward and upward. Comminution of the fragments frequently occurs, due to the severe force to which the upper portion of the body is liable. The superficial position of the tibia renders likely a tearing or puncturing of the overlying skin and superficial fascia by the upper tibial fragment. This is probably the most common site in the body for compound fractures. This superficial position of the tibia is an aid to the correct diagnosis of fracture, as the displacement and line of fracture can be seen and felt. This, in conjunction with the ordinary signs of fracture, make a diagnosis comparatively easy and certain. The position of the anterior and posterior tibial vessels renders them liable to severe injury in this class of fractures and one should always satisfy himself as to their condition before instituting treatment. The pulse below the site of fracture is the indicator. Another important consideration, particularly as to prognosis, is the liability to an associated disarrangement of the articular surface of the astragalus, tibia, and fibula. They are usually mechanically disarranged and if this be not corrected by proper adjustment of the fragments permanent disturbance of the joint will result.

Traumatic arthritis is also a common result of the force necessary to bring about the fracture, and, therefore, in this fracture passive motion should not be commenced too early, and when started should be carried out with the greatest gentleness.

Most modern authorities place the limb in a plaster cast immediately after reduction. By the use of the split plaster cast in experienced hands excellent results will be obtained. There is, however, a distinctly increased risk, due to the swelling of the limb in a dressing of this kind. I have not abandoned the fracture box. It is safe and efficient and one can see the limb without disturbing the dressing, and I therefore recommend its use for the first ten days or two weeks. This point will be appreciated by hospital surgeons, who must necessarily leave the routine treatment largely in the hands of the interne, whose experience in plaster work is, as a rule, limited.

The rule that the joints to both sides of a fracture should be immobilized is of special application in fracture of the leg.

Fracture of both bones of the leg at or near the ankle constitute a class of fracture in themselves. The functional or anatomic



involvement of the ankle joint and the fact that the breaking force is excited through the foot are points common to most of these fractures.

In the fracture of both bones above the malleoli (Figs. 23 and 24), the lines of fracture are varied and permit of no special classification. The fragments of one or both bones may be comminuted. The shaft of both bones may be broken and the malleoli may also be broken. In youth the epiphysis of one or both bones may be separated. Fracture of both malleoli (Fig. 25) is common. A small fragment of either malleoli may be torn off (Fig. 26), constituting a sprained fracture. Under this latter class come most of the so-called sprained ankles. The ligaments of the joint are stronger than the bone to which they are attached, and when the breaking strain comes the bone gives way, causing a true fracture. Wilbert and I have proved this point not only in injuries to the ankle joint, but in all the joints subject to breaking force.

There is one fracture at the ankle which from the frequency of its occurrence, the overlooking of the cardinal principle of treatment, and the great deformity and disability resulting therefrom, deserves special mention—Potts' fracture.

Percival Potts, F.R.S., in his *chirurgical work*, vol. 1, page 433, published in 1783, ably describes this fracture, and it is known by his name to this day (Fig. 27). I quote at length from his description:

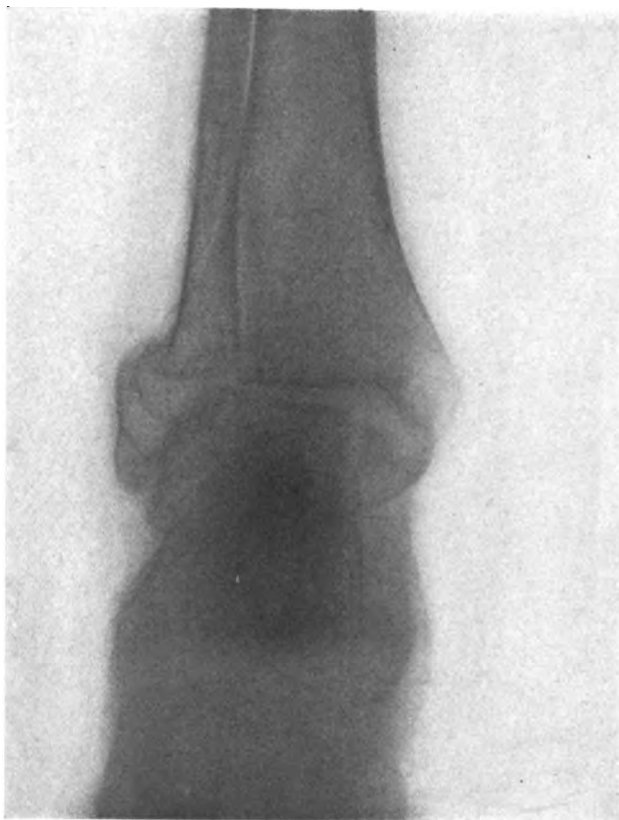
“Whoever will take a view of the leg of a skeleton, will see that, although the fibula be a very small and slender bone, and very inconsiderable in strength when compared with the tibia, yet the support of the lower joint of that limb (the ankle) depends so much on this slender bone that without it the body would not be upheld nor locomotion performed without hazard of dislocation every moment. The lower extremity of this bone, which descends considerably below the end of the tibia, is by strong and inelastic ligaments firmly connected with the last named bone and with the astragalus, or that bone of the tarsus which is principally concerned in forming the joint at the ankle. This lower extremity of the fibula has, in its posterior part, a superficial sulcus for the lodgment and passage of the tendons of the peronei muscles, which are here tied down by strong ligamentous capsulæ, and have their



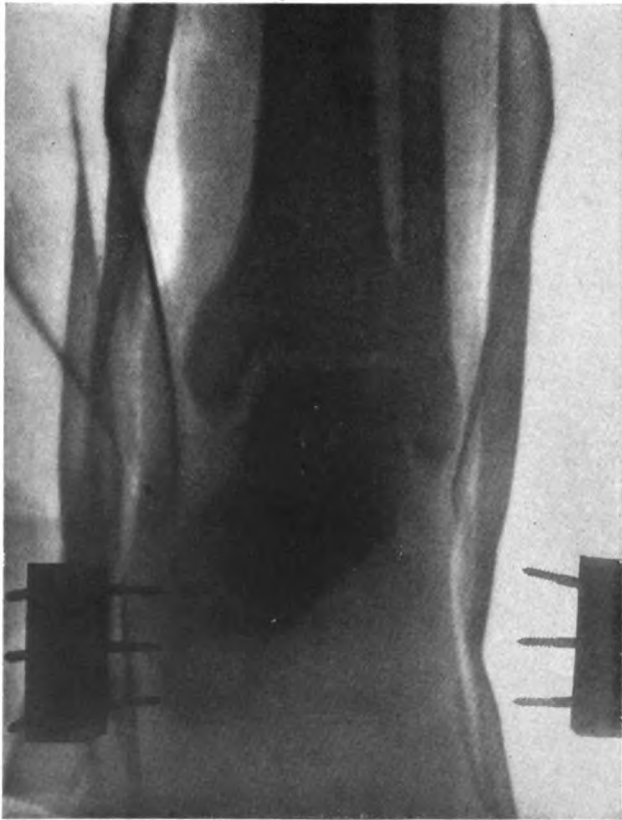
**FIG. 23.**—Comminuted fracture of both bones of the leg.



**FIG. 24.**—Comminuted fracture of the tibia : simple fracture of the fibula.



**FIG 25.—Fracture of both malleoli.**



**FIG. 26.—Fracture of the external malleolus; good position in a fracture box.**



**FIG. 27.—Fracture of the internal malleolus and shaft of the fibula.  
Pott's fracture.**



action so determined from this point or angle that the smallest degree of variation from it, in consequence of external force, must necessarily have considerable effect on the motions they are designed to execute, and consequently distort the foot. Let it also be considered that upon the due and natural state of the joint of the ankle, that is, upon the exact and proper disposition of the tibia and fibula, both with regard to each other and to the astragalus, depend the just disposition and the proper action of several other muscles of the foot and toes, such as the gastrocnemii, the tibialis anticus and posticus, the flexor pollicis longus, as must appear demonstrably to any man who will first dissect and then attentively consider these parts.

“I have already said, and it will obviously appear to every one who examines it, that the support of the body and the due and proper use of the execution of the office of the joint of the ankle depend almost entirely on the perpendicular bearing of the tibia upon the astragalus and on its firm connection with the fibula. If either of these be perverted or prevented, so that the former bone is forced from its just and perpendicular position on the astragalus, or if it be separated by violence from its connection with the latter, the joint of the ankle will suffer a partial dislocation internally, which partial dislocation cannot happen without not only a considerable extension or perhaps laceration of the bursal ligament of the joint, which is lax and weak, but a laceration of those strong tendinous ligaments which connect the lower end of the tibia with the astragalus and os calcis, and which constitute in great measure the ligamentous strength of the joint of the ankle.

“This is the case when by leaping or jumping the fibula breaks in the weak part already mentioned, that is, within two or three inches of its lower extremity. When this happens the inferior fractured end of the fibula falls inward toward the tibia, that extremity of the bone which forms the outer angle is turned somewhat outward and upward, and the tibia, having lost its proper support and not being of itself capable of steadily preserving its true perpendicular bearing, is forced off from the astragalus inwards by means of the weak bursal or common ligaments of the joint, violently stretched, if not torn, and the strong ones which fasten the tibia to the astragalus and os calcis are always lacerated, thus



producing at the same time a perfect fracture and a partial dislocation, to which is sometimes added a wound in the integuments made by the bone at the inner ankle. By this means, and indeed as a necessary consequence, all the tendons which pass behind or under, or are attached to the extremities of the fibula and tibia or os calcis, have their natural direction and disposition so altered that, instead of performing their appointed actions, they all contribute to the distortion of the foot, and that by turning it outward and upward."

The cause of Potts' fracture is forcible eversion and abduction of the foot; a twisting force.

Stimson<sup>2</sup> describes two main varieties of this fracture, according to whether eversion or abduction predominates:

"If eversion is the sole or main movement, the force is exerted through the internal lateral ligament and breaks the internal malleolus squarely off at its base; then it presses the external malleolus outward, rupturing the tibio-fibular ligament, and breaks the fibula close above the malleolus. Sometimes instead of pure rupture of the tibio-fibular ligament, there is avulsion of the portion of the tibia to which it is attached, in front or behind or both, but I believe this to be rare. These lesions can be easily produced experimentally by fixing the foot in a vise and pressing the upper part of the leg outward.

"If, on the other hand, abduction of the front of the foot is the principal movement the first and last of these three lesions vary. Instead of a square break of the internal malleolus at its base there is an oblique, almost marginal, fracture of its anterior portion, or, more commonly, there is a rupture of the anterior portion of the internal lateral ligament; then follows rupture of the tibio-fibular ligament, and, as the movement continues, the torsion of the fibula produces an oblique fracture, the upper end of which is found three or four inches above the tip of the malleolus. If the movement is arrested in time fracture of the fibula may not occur."

The appearance of Potts' fracture is so characteristic of the injury that the diagnosis is at once apparent. The eversion of the foot, the lateral mobility of the ankle, the prominence of the internal malleolus or the lower end of the tibia, the three constant

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<sup>2</sup> Fractures and Dislocations, page 385.

points of tenderness, will confirm the diagnosis. The first of the tender points to be noted is over the tibio-fibular ligament anteriorly, the second over the fractured internal malleolus, and the third over the fracture of the fibula.

In addition to the lateral displacement there is apt to be backward dislocation if the entire internal malleolus is separated from the shaft.

To reduce the fracture make pressure forward with the hand on the heel and then forcibly invert the foot. If the backward dislocation shows a marked disposition to recur it may be necessary to cut the tendo Achillis.

An external lateral and a posterior splint made of plaster or binder's board, if properly molded and applied, will keep the fracture in place. The fracture box will also answer very well. By placing a pad (a rolled bandage answers very well) to the outer side of the foot below the fibular fracture and one on the inner side above the tibial fracture, the tendency to eversion will be overcome. A well-applied split cast of plaster will answer all indications. It is my practice to use the fracture box for 10 days or two weeks in the severe cases, and then a plaster cast. In the less severe cases, when the deformity is not so great, a cast can be used at once. It is necessary in this class of fracture to maintain the reduction while the plaster is setting. This can be accomplished by sand bags laid alongside of the leg and foot, or by the hands of an assistant, or by a straight splint bound to the outside of the leg. In case of backward dislocation the heel must rest on a support.

A fracture similar to the above occurs when the breaking force is applied with the foot inverted. Here the fibula is broken first and then a portion or all of the internal malleolus follows. The diagnosis is made by the appearance of inversion,—although it is never so marked or characteristic as the eversion in Potts' fracture,—by the localized tenderness over both fragments, and the abnormal mobility of the external malleolus.

A plaster cast is the best treatment for this class of ankle fractures. In the severest type, when the internal malleolus is entirely broken off, it must be replaced before the dressing is applied, so as to prevent permanent widening of the mortise joint.

*Fractures of the astragalus* are commonly caused by force

applied to the heel, as when falling from a height and landing on the feet. The bone is forced between the os calcis and the tibia. It is usually associated with fracture of the os calcis. It is difficult to recognize clinically, although the character of the fall and the location of the tenderness will lead to well founded suspicion. The x-rays may be of great help in clearing up the diagnosis.

The treatment is to place the injured foot in a plaster cast extending from the root of the toes to the tibial tubercle. It is especially important to see that the foot is at right angles to the leg and is so maintained until the plaster is set, as ankylosis is probable.

*Fracture of the os calcis* occurs as a result of direct violence, as from a fall upon the foot from a height or by a contraction of the powerful muscles that find attachment to this bone through the tendo Achillis (Figs. 28 and 29). The bone is usually splintered or crushed.

The diagnosis is made by the history of sufficient force applied to the bone, by the localized tenderness, by the flat appearance of the heel when compared with its fellow of the opposite side, and by the slightly relaxed condition of the tendo Achillis. The x-rays will be of great value in corroborating the clinical diagnosis.

Sprained fracture in which there is an avulsion of a portion of the os calcis, to which the tendo Achillis is attached, is not a rare accident. It is readily understood that, when the powerful action of the calf muscles is exerted, it is the bone and not the tendon which tendon which gives way.

The foot and leg should be placed in a plaster cast in extreme flexion, so as to relax all pull of the gastrocnemius and soleus. It is advisable at times to flex the knee as well, extending the cast to the thigh for this purpose.

Fracture of the metatarsal bones (Figs. 30 and 31) occurred alone or associated with fracture of the tarsus or phalanges 148 times in 2,500 cases (Ross and Wilbert). There were 114 cases of fracture of the metatarsals.<sup>3</sup> It is therefore not an uncommon fracture. Indirect violence is the most common cause, as by muscular action when jumping. It does occur as the result of direct violence, as from the falling of heavy weights on the foot.

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<sup>3</sup> These statistics do not include crushing injuries.

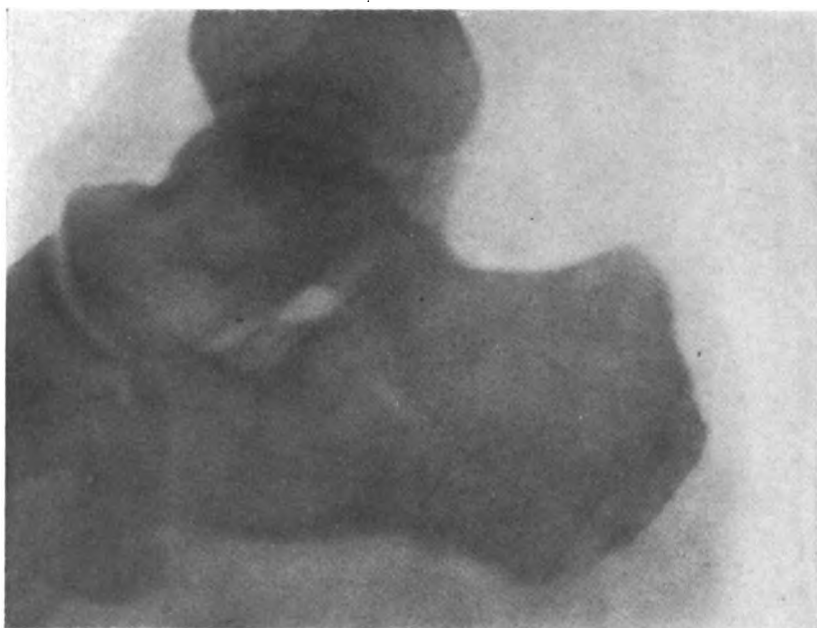


FIG. 28.—Fracture of the os calcis.



FIG. 29.—Sesamoid bone back of the astragalus—not to be mistaken for a fracture.



**FIG. 30.**—Fracture of the shaft of the first metatarsal bone.



**FIG. 31.—Fracture at the base of the fifth metatarsal bone.**

The diagnosis is made by the localized pain, crepitus, and abnormal mobility. The fracture is not a serious one if recognized and properly treated. A plaster cast is the best method of fixation. It should extend above the ankle.

*Fractures of the phalanges* are the result of direct violence and are usually compound, hence their danger and importance. Careful asepsis will suffice to remove this danger and the dressing will be sufficient support for the fracture.

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## SUGGESTIONS IN THE TREATMENT OF HIP-JOINT DISEASE

A CLINICAL LECTURE DELIVERED AT THE NEW YORK ORTHOPEDIC HOSPITAL AND DISPENSARY

BY RUSSELL A. HIBBS, M.D.,

Surgeon-in-Chief of the New York Orthopedic Hospital and Dispensary

GENTLEMEN: In the early stage of hip-joint disease the two principles of treatment are fixation and traction. We wish to permit the children to continue on their feet, and for this purpose we employ a splint that secures three things: (1) immobilization; (2) traction; and (3) the prevention of the child's bearing its weight upon the diseased joint surfaces. The old Taylor splint, somewhat modified but in principle the same as before, is best adapted for these purposes. In order to accomplish these indications, this splint formerly had to be made very cumbrously. It had to be strong enough to bear the child's weight, and the difficulty was to avoid making it so heavy that it would not be a burden to the patient. In recent years we have secured an ideal modification of the splint by employing steel tubing instead of the rolled sheet steel formerly employed, and this is advantageous not only from the point of view of lightness and durability but also because it is less expensive. Expense may not seem an important matter in private practice, but here in the hospital where hundreds of the splints are employed every year, this consideration is not without its weight. It makes a difference of three to five dollars in every hip splint.

Entirely too many orthopedic surgeons entrust the making of their apparatus to the instrument maker without themselves thoroughly understanding the mechanical principles involved and the problems in material and construction which must be overcome. Orthopedic apparatus have improved only in so far as surgeons themselves have learned every detail of the making of apparatus and have lent their professional attention faithfully to its improvement. The instrument maker knows nothing at all of the anatomic

problems involved, and besides he is only an artisan following closely the lines of his model, and improvements cannot be looked for from him. The history of orthopedics shows that amelioration in instrumental conditions has always come from the surgeon.

If the extension is to be properly applied it is important that the plaster selected be sufficiently long so that the extension or traction force shall be effective mainly from the thigh and not from the leg below the knee. If in the course of extension considerable traction is applied from below the knee, the knee-joint becomes relaxed and does not readily return to a healthy condition after the long time required for the treatment of hip-joint disease. If possible the plasters applied at the beginning should not be removed so long as they remain securely adherent to the leg. This will not be long if the plaster employed for the attachment of the apparatus to the limb produces irritation. There are two qualities then that the adhesive plaster must have: It must be strong and must not easily produce irritation. If excoriations are produced the extension must be discontinued for a time and this always delays the cure. The ideal in treatment by traction is if possible to make it absolutely continuous until joint inflammation has subsided.

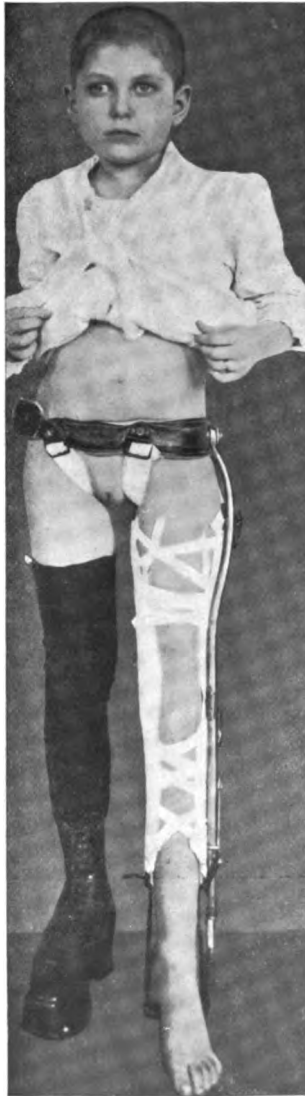
The first piece of plaster should be cut in a length that reaches from the umbilicus to the sole of the foot. The width of the plaster depends on the size of the leg, but should be from about four to six inches. The best buckles for the apparatus are ordinary harness buckles which should be sewed firmly to the end of the plaster. Strips of plaster about one inch in width should be cut from the side of the long piece but allowed to remain attached to it as tails and these are applied in spirals to the thigh so as to secure the main portion of the traction being exerted upon this portion of the limb (Fig. 1). The application of the plaster should always be made by the surgeon himself as nurses cannot be depended upon to apply it properly. When the plaster is nonirritating in quality and the patient's cutaneous condition is reasonably normal, such a traction apparatus may be allowed to remain for many months. I have seen one stay firmly in place without any necessity for renewal for thirteen months yet without the production of an excoriation of the skin of any kind. As a rule the plaster portion of the apparatus does not need renewal oftener than from six to

eight weeks and of late years the average is going as high as three months.

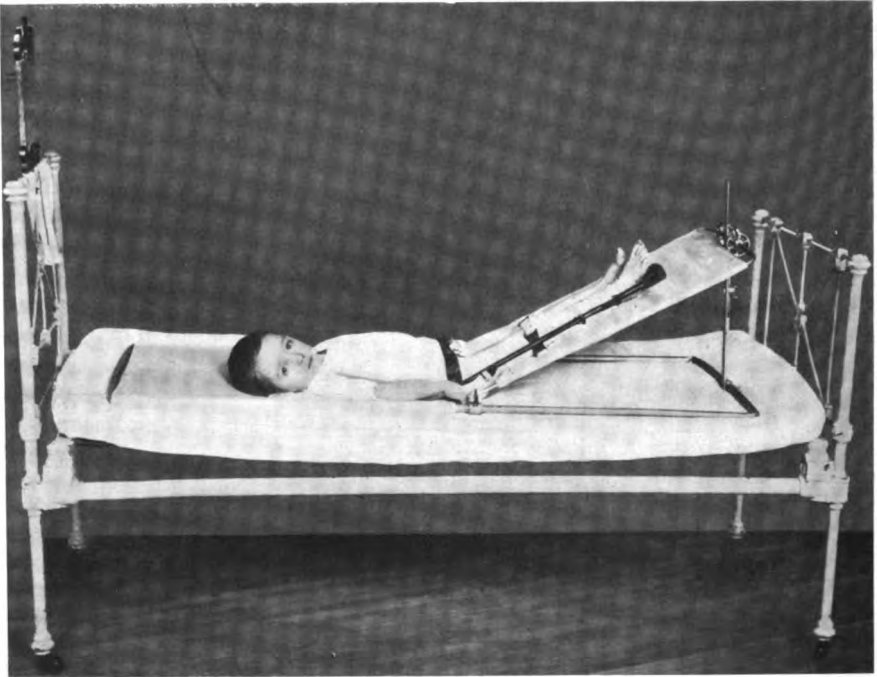
It is often thought that extension should only be applied to hip-joint cases that have not suppurated, or at least that whenever there are running sores with many sinuses it is almost absurd to think of extension doing any good. This is an entirely mistaken notion that keeps many a child suffering from tuberculous disease of the hip much longer than would otherwise be the case. If extension is needed in milder cases then surely it is indicated in severe forms of the disease. The idea of extension is to keep diseased joint surfaces from irritating each other by being rubbed together. During the course of suppuration it is even more important to prevent this added irritation of friction than when there is only a focus of softening present in the head of the femur or in the acetabulum.

The benefit that may be derived from extension in suppurative cases is very well illustrated by this little girl who came here four years ago after all sorts of operative procedures had been employed to put an end to the extensive suppuration in and around the hip-joint. All treatment had proved a failure. At no time, however, during the course of the affection had extension been employed. The pus had been evacuated but there had never been any thought of the necessity for protection of the diseased articulation from the friction of its own movements. The suppuration was apparently so hopelessly progressive that amputation was under consideration and it was the surgeon's discussion of this with the mother that led her to bring her child here. Immediately on entrance here, extension was employed (Fig. 2), and amelioration of the condition set in at once. Now, after four years, the child has an excellent joint. As you see there is flexion to  $90^{\circ}$  with good abduction and adduction, and while there is some lameness in walking it is due to the shortening and not to interference with motion within the hip-joint.

After you have seen a number of cases like this, you will not be surprised at my hesitation in operating upon tuberculous joints in children. I can show you hundreds of such cases in which the following out of the indication to set the joint absolutely at rest has resulted in excellent functional cures. This child has actually



**FIG. 1.—Showing the hip splint in position and the arrangement of the adhesive plasters for the treatment of tuberculous hip-joint disease; the walking position.**



**FIG. 2.—Treatment of flexion deformity in tuberculous hip-joint disease. Extension with the limb on an incline for the correction of angular deformity.**

improved in the marvelous way that I have shown you notwithstanding the fact that there is an acute tuberculous process, which has developed in her shoulder during the course of the cure of her hip. This shows that she is especially susceptible to tuberculosis and that her tissues have very little resistive vitality against the bacillus. In spite of this her hip is completely cured and will probably never show any symptoms of the disease.

There is some shortening, of course, and unfortunately with the progress of growth this shortening will be increased. It is not what would be called serious shortening, however. It amounts to about one inch now and when she grows up will amount perhaps to two inches. She can wear a shoe that is perhaps an inch and a half higher than that on the other foot and this will prove quite sufficient to make her walk with comfort and without noticeable deformity. Complete correction of the shortening should not usually be made by means of a high shoe, as the patients accommodate themselves a little better to a slight difference in the length of the limbs. Orthopedists sometimes say that when the function of a joint is completely recovered the original process was not tuberculous. In this case, however, there can be no possible doubt of the tuberculous nature of the disease, and it serves to illustrate very well how much can be done by conservative methods.

I shall show you other cases in which large abscesses formed and in which there was spontaneous discharge of pus, yet they were never touched with a knife and the result secured is more satisfactory than is possible under any form of operative methods. When the abscesses open of themselves, the cicatrices that form on healing are always less bothersome than those that result from surgical incision.

Here is a patient in whom there is, as you see, excellent flexion—nearly  $90^{\circ}$ ; this will increase after the splint has been off for some time. It is six years now since this patient first came under our treatment and you can see the scars of fistulæ that formed as the result of the spontaneous opening of the abscess in the joint. The result as regards function of the joint is excellent. Six years seems a very long time to wait, but it is absolutely no use to become impatient and operate, since operation will not hasten the process of cure and the ultimate result is not likely to be so good as without

operation. This lesson of patience and conservatism is the main element in the treatment of joint tuberculosis in children that the modern student of orthopedics must impress upon himself.

Here is a little patient who is extremely interesting because we have never been able to apply extension continuously but have had to interrupt it on account of the extreme irritability of her skin, which became repeatedly excoriated no matter what kind of adhesive plaster was applied. As the result of keeping her quiet as much as possible, however, during the intervals in which extension could not be employed, an excellent result is gradually being obtained. I would gladly have any suggestions with regard to the healing of these skin lesions so as to allow of the application of plaster and have consulted various specialists with regard to the subject, but without success. You will meet with such patients and must simply treat them as best you can under the circumstances, but must not allow their skin to become so excoriated as to make it another source of discomfort and consequent deterioration of general health. Remember that tuberculous patients require most of all to have their vitality at its highest and hence need constant care for the removal of all pathologic conditions.

I have here a little patient aged twelve who has been under our treatment in the hospital for some five years. She is now so far recovered as to have good motion in the joint in every direction. Quite different from our first case to-day, this one presents no signs of suppuration having taken place, there are no traces of fistulous openings and as a matter of fact there is no history of pus formation in the case. The shortening on the affected side, however, is already more than two inches and will increase somewhat with the child's growth. It may seem surprising that so much shortening should occur in a case in which there has been no pus formation. As a matter of fact, however, in tuberculous cases in which there is considerable pus formation, it is the soft tissues around the joint that suffer most during the purulent process.

Over and over again I have noticed and have called attention in this course to the fact that cases without suppuration are the most disastrous in the destruction of bone that takes place. In the statistics of 150 cases that I have published this fact is very prominent. Our experience in hip disease in this matter is confirmed by

what is commonly seen in Potts' disease. In lumbar Potts' disease there is usually very extensive and prolonged suppuration. As a rule, however, there is much less deformity, very little kyphosis, and autopsies show little wasting of bone. In dorsal Potts' disease, however, in which extensive suppuration is much rarer, the deformity is always greater and nonsuppurative cases are sometimes complicated by enormous destruction of bone. This is demonstrated also in the autopsies which often show the disappearance of the bodies of three or four or even more bodies of the dorsal vertebrae.

In the application of the splint in these cases it is not wise to make the shoe on the well limb too high. The toe of the affected limb should be allowed just to touch the ground. This gives the little patients more confidence in walking and instead of tempting them to use their diseased hip-joints actually seems to serve a definite purpose in preventing certain awkward movements in walking by which the affected hip-joint not infrequently appears to be irritated. The pelvis should be allowed perfectly free movement so that the patient can tilt it at will in order to make up for the new condition of affairs necessitated by the presence of the splint in walking. Some orthopedists employ a thoracic band endeavoring thus to immobilize the lumbar spine. This simply increases the difficulties of securing proper adaptation of the apparatus since there is an attempt to immobilize four or five healthy joints. As the treatment must be tedious at best and takes a long, long time, such a mistaken attempt, always unsuccessful, only adds to the patient's discomfort by doing more than is absolutely necessary and is almost sure to be harmful in its consequences rather than beneficial.

It must never be forgotten that hip-joint disease is a tuberculous process and that the cure of tuberculosis no matter in what part of the body it may be depends more on the general condition of the patient's health, than on any specific remedies or method of treatment that can be employed. This is what the specialists in pulmonary tuberculosis have learned in recent years and it is the lesson that we must learn from them. I remember once talking with one of our most distinguished American specialists in this department of therapeutics in reference to this subject and he said that the orthopedists had taught the general practitioners a very important lesson. This consists in the necessity of keeping tissues affected by



tuberculosis at rest. The rule in the treatment of pulmonary tuberculosis years ago, was that the patients should be advised to take long walks and considerable outdoor exercise, with at times even rather violent gymnastics indoors, with the idea that an increase in the respiratory function lessened the tendency of their tuberculosis to advance. The success of the orthopedists with just the opposite idea of absolute rest proved the falsity of this old opinion. The lung cannot be absolutely immobilized as can the hip, but as far as possible the general practitioner now keeps his tuberculous patients at rest, giving the lung as much rest as possible.

The orthopedist must now learn the lesson from the general practitioner of having his little patients stay as much in the air as possible and have them fed an abundance of nutritious food. If this be done hip-joint disease becomes one of the most curable of affections. It takes a long time, but it requires only patient and painstaking care without the necessity for more than ordinary surgical skill. Patience is very important, but given that, good results are sure to come. As an illustration of this I have here a case of double hip-joint disease which seemed very hopeless at one time yet is now practically entirely well. During the course of our treatment of one hip, a tuberculous process started in the other. As is the rule in these cases the joint which was last affected became well first and there are now no traces at all of the affection that ran its course in it. In this patient you may note the influence of heredity. The child's mother suffered from knee-joint disease thus showing that the family tissues have very little resistive vitality to the tubercle bacillus and that there is a distinct predisposition therefore to the acquisition of the disease.

In closing, then, I feel that I must impress upon you that no matter how large an abscess may develop in the hip-joint, so long as it does not interfere with the application of the traction apparatus it should not be operated upon. Even considerable abscesses often disappear spontaneously and the result is invariably much better when the cure is thus left to nature than it would be under the nicest surgical intervention. Even though the case seems almost acutely progressive when it comes under treatment, if traction is properly applied the main cause for irritation within the joint is done away with and it will not be long before distinct improvement

will be noticed. So long as the abscess remains unopened there is no septic temperature. As a rule infection takes place almost inevitably within a few days after the abscess has been opened either by nature or by the surgeon's knife.

To my mind there is only one exception to this rule with regard to the advisability of not opening tuberculous abscesses in joints. The single exception is the knee-joint. In this the serous surface of the knee is so extensive, there are so many pockets, so many opportunities for pus to burrow, so little opportunity for nature to relieve herself by absorption, that thorough opening and drainage seems indicated. Several openings, as a rule, will have to be made into the knee joint and kept thoroughly patent for some time in order to secure the continuance of proper drainage.

# **TUBERCULOUS HIP-JOINT DISEASE; OSTEOMYELITIS AND TRANSPLANTATION OF THE FIBULA; AND ANKYLOSIS OF THE JAW**

**A CLINICAL LECTURE**

**BY JAMES F. RINEHART, M.D.**

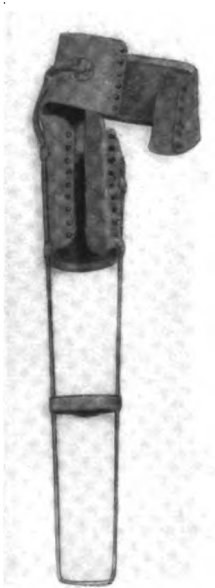
Consulting Surgeon to St. Anthony's Hospital, Oakland, California

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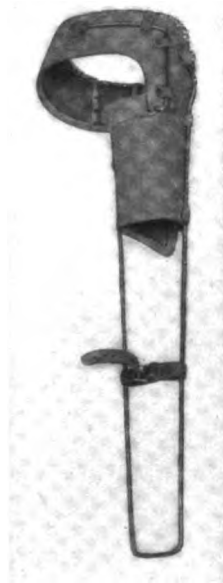
GENTLEMEN: My object in speaking to-day upon tuberculous hip-joint disease is twofold: First, I desire to urge upon you the necessity of carrying out certain routine methods of examination in all cases of children's diseases, no matter whether there is any apparent indication for such an examination or not. Indeed, this is the only way a great many of the diseases of childhood can be diagnosed early enough to make treatment of any avail. For instance, let me mention diphtheria, in which the treatment must be begun early if it is to be effective, or acute nephritis, which is so obscure in its early symptoms that it would be almost certainly overlooked without a most thorough search of all the body. Note, then, how important becomes the routine of looking into the throat and examining the urine.

This is very true of hip-joint disease also, because in no disease is the beginning more clouded by obscurity. There may not have been even a pain or stiffness on rising—only a failure on the part of the child to thrive. Observe, then, if one limb is smaller than the other, or if there is flexing of either leg upon the pelvis. This is followed later by abduction or apparent lengthening, but to be able to detect the trouble early the sign of simple flexion should be sought.

Another diagnostic measure is to place the child upon its back upon a hard table. Upon straightening the legs it will be found that the sound limb may be made to rest its full length upon the table without producing any change in the contour of the spine; but that, when the affected limb is straightened and the knee pressed



**FIG. 1.—Front view of the Vance splint.**



**FIG. 2.—Rear view of the Vance splint.**



down, there is a decided arching of the spine, and that, in order to make the spinal column rest evenly upon the table, it will be necessary to elevate the affected limb to an angle of twenty degrees or more, as the case may be, from the table.

Other signs are that the crease between the nates is inclined in the early stages of the disease toward the sound and away from the affected side, and that the gluteal fold is lessened on the side which is diseased.

My second object is to urge the necessity of early ambulatory treatment. The advantages to the child, which accrue from its being able to take out-door exercise and fresh air, are very greatly overbalanced by any slight injury which may be done to the joint by the motion which must necessarily go along with the ambulatory splint. These splints can now be had of good instrument-makers, or, in case the physician lives away from the centers of trade, may be made by himself. The one described herewith was originated by Dr. A. M. Vance, of Louisville, Ky., and has been very successfully used by him and also by myself in a number of cases (Figs. 1 and 2). It is spoken of but not fully described in a number of text-books upon surgery under the name of "The Leather Splint of Vance." The advantages of this appliance are: (1) It is inexpensive; (2) it can be made and applied by anyone who has ordinary skill as a mechanic himself or has access to the shops of a harness-maker and plumber; (3) it can be removed, cleaned, and replaced by the mother or nurse; and (4) it fulfills all the indications of fixation and extension in the most perfect manner.

The materials necessary for this splint consist of a piece of leather, such as is used for making saddle skirts, a piece of brass rod of from one-fourth to one-half inch in diameter (according to the size of the patient to be treated) and of sufficient length to fill the measurements to be hereafter explained, some hooks such as are used on the ordinary shoe for men, a few rivets, and a small piece of kid or sheep's leather for making a pad upon which the ischium rests and supports the body weight.

The measurements to be taken are as follows: The circumference of the body at a point on a level with the crests of the iliac bones, the circumference of the body at the intertrochanteric line, the circumference of the affected limb as high as it can be taken, and

again at a point just above the knee. The distance should be also measured from the crest of the ilium to the trochanter on each side, and from the trochanter of the affected side to the lower leg measurement already taken. A figure should then be drawn with the top measurement as its top, the distance from the top to the lower leg measurement as one side, as shown in the figure below, as a pattern from which to outline the leather part of the splint. (Fig. 3.)

Let A-B be the first circumference of 20 inches, G-C be the second of 22 inches, G-D and F-E the leg measurements of 12 and 10 inches, A-G and B-C the distance between the iliac bones and the trochanters of 8 inches, and G-F and D-E the length of the part to cover the leg. The figure A, B, C, D, E, F, G, will represent the

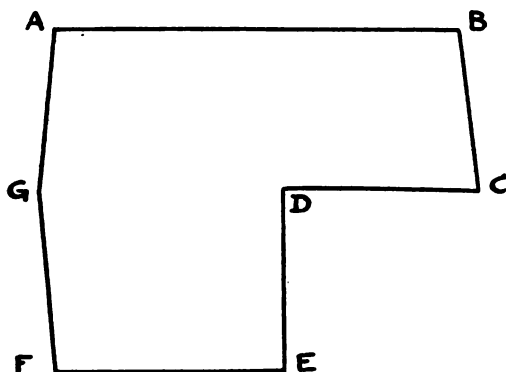


FIG. 3.—Outline of the leather pad for the Vance splint.

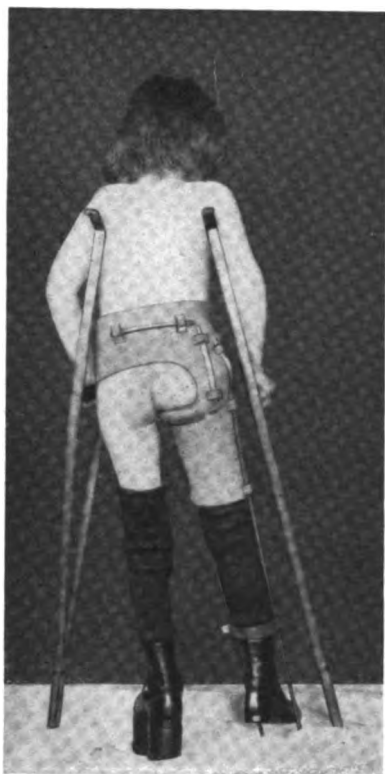
pattern. The leather is cut in the shape and with the measurements to correspond with the pattern made as above directed. The leather as shaped is then thoroughly wet in warm water and applied to the pelvis and affected limb in the form of a splint, the smooth or hair-side of the leather next to the bare skin. The leather should be held snugly in place with a roller bandage, going from the knee upward, in the manner of the ordinary spica as applied to the hip. This should be left on over night, when it can be removed and will be found to conform perfectly to the form of the pelvis and thigh.

The next step in the making of the splint is the application to this leather cast of the brass tubing or rod as follows: Beginning at a point near the front of the meeting of the two upper flaps on



**FIG. 4.—Vance splint applied.**





**FIG. 5.—Vance splint applied.**

the side of the diseased joint the rod is carried backward to a point half way between the crest of the ilium and the great trochanter of the affected side; thence it is turned downward, being bent in each instance to the shape of the leather part of the splint, and carried in a straight line down the outside of the leg to a point 3 inches below the sole of the foot; thence across the foot; thence upward on the inside of the leg to the crotch; thence backward along the line of the gluteal fold to a point near the great trochanter; thence upward to a point on a level with its beginning; thence around the back of the body to a point midway between the crest of the ilium and great trochanter of the sound side.

The brass rod thus placed will be found to form a framework for the leather part of the splint, and will also constitute a support for the weight of the body. The brass rod so fitted is fastened to the leather part of the splint by means of small pieces of leather riveted over the rod at short distances, the smooth end of the rivet being, of course, inside next the skin. A pad of horse-hair covered with sheep-skin is sewed neatly over that part of the rod which follows the gluteal fold, and in such way that the weight of the body may be supported upon the ischium as it rests upon this pad. The weight of the body will then be found to be supported on the rods by the pad supporting the ischium, and taken off the hip-joint. The edges of the splint in front where they meet should be smoothed off, a tongue sewed under them and hooks fastened on as on the front of a shoe for lacing. The shoe of the opposite foot should be of cork and three inches high. The leather part of the splint should be shellaced, as it is more easily kept clean.

The lower part of the splint should be provided with a strap to hold the foot in position, the strap being simply buckled around the splint so as to include the ankle. In case more extension is deemed advisable than is provided by the simple weight of the affected limb, it may be accomplished by a strap fastened to the sole of the shoe and reaching to the bottom of the splint.

The accompanying illustrations (Figs. 4 and 5) show the front and back views of the splint applied to a patient treated by me in whom the result was all that could be desired.

## OSTEOMYELITIS AND TRANSPLANTATION OF THE FIBULA

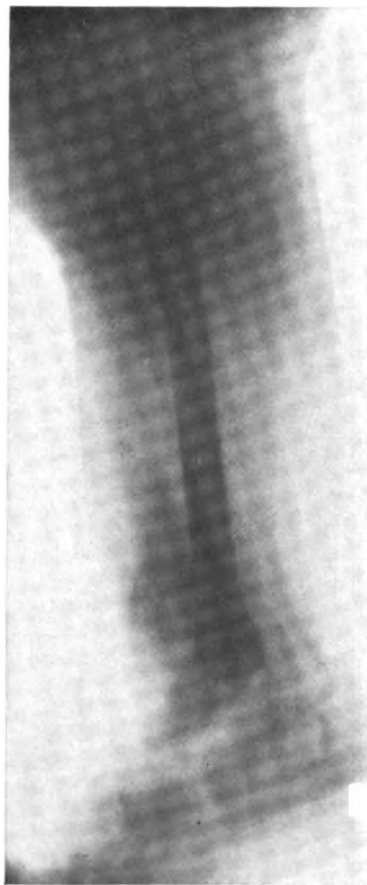
In July, 1904, I was called to see J. S., aged 6 months, who had been treated by poultices for an osteomyelitis affecting the tibia of the left leg. There were several openings in the skin along the course of the bone through which a probe could be made to pass down to the bone, which was rough and completely necrosed. An incision was made under chloroform anesthesia along the crest of the tibia of sufficient length to extract the bone, which was completely separated from the periosteum from one epiphysis to the other. The part removed was three inches in length, and left, when it was removed, a canal surrounded by periosteum of the same length and size as the bone.

Some effort was made to pack this canal and keep it open in the hope that new bone would be formed, but the canal rapidly closed so that soon no packing could be introduced and the wound was permitted to close. The accompanying cut (Fig. 6) will show the condition of the limb after it had completely healed; the skia-gram (Fig. 7), which was made just prior to an operation, which was undertaken May 20, 1905, for the relief of the condition, will show that there had been only slight reproduction of bone near the two epiphyses, and none near the center of the bone.

On May 20, 1905, Dr. J. M. Milton assisting, an operation was done to put the fibula in place of the tibia, which had been previously removed as described. The method followed was as follows: A long incision, extending from just below the knee joint to a point just above the ankle and along the former course of the tibia, was made through all the structures down to the fibula. The pointed ends of the partially reproduced tibia were cut squarely across just below the upper and just above the lower epiphyses. The muscular attachments were separated from the cord-like tibia and the part between the epiphyses was removed. Then, with an elevator, the part of the fibula lying next to the tibia was stripped of its muscles, the muscular tissue being so separated that those in front of the fibula and also those behind it should be as little disturbed in their relations as possible. Two short incisions were then made on the outer part of the leg, one over the upper end of the fibula and the other over the lower end. Measurements were made of both



**FIG. 6.**—Showing the leg before operation.



**FIG. 7.—Skiagram of the leg before operation, showing the tibia only partially reformed.**



**FIG. 8.—Showing the leg after operation.**

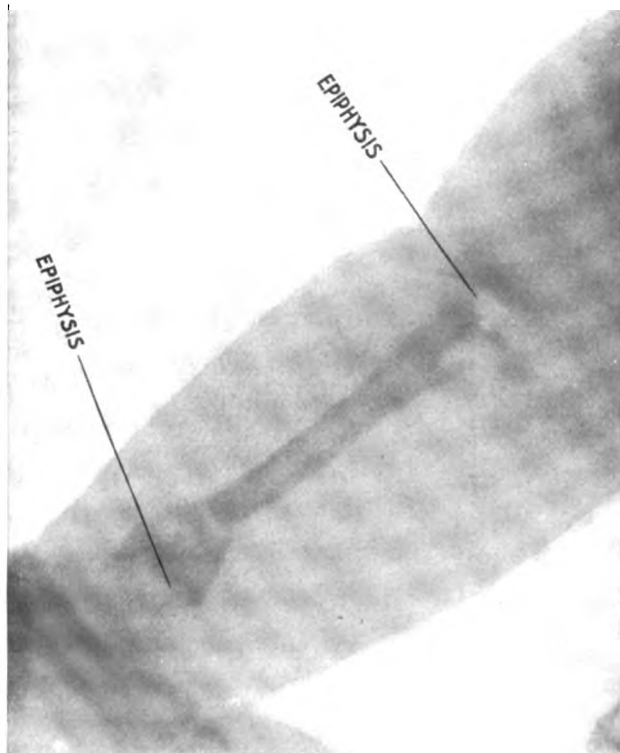


FIG. 9.—Skiagram of the leg after operation, showing the transplanted fibula.



**FIG. 10.—Ankylosis of the jaw. Before operation.**





**FIG. 11.—Showing the line of incision.**

legs, and a piece of the fibula was excised of sufficient length that when placed into the former seat of the tibia the two legs were of equal length. This piece of bone, with the muscular attachments still present on its outer and posterior aspects, was then pushed over into the place formerly occupied by the tibia. The incisions were sewn together and the limb was held in proper position by those assisting until a plaster cast was applied.

The bone united to the epiphyses of the tibia, the incisions closed, and the result was as shown in the accompanying photograph (Fig. 8) with its corresponding skiagram (Fig. 9), which were taken two months after the operation was done. The leg was fitted with a brace, which the child still wears as a matter of precaution, yet the result is all that could be desired, the bone being of sufficient size and firmly enough united to bear the entire weight of the body.

#### ANKYLOSIS OF THE JAW

M. F., a Portuguese, aged 17 years, had had ankylosis of the lower jaw, partial at first, but gradually growing worse for the past five years. Examination showed that he was poorly nourished from the fact that he had been unable to properly masticate his food. His lower jaw was not larger than it should have been at 12 years of age. He was able to open the jaw only one-eighth of an inch (Fig. 10). Forcible efforts to open his mouth were accompanied by severe pain and a sense of resistance on the right side. On this account it was decided to operate first upon that side, and, if that did not entirely relieve the ankylosis, to operate upon the other later.

On February 4, 1906, Dr. M. M. Enos assisting, an operation was done as follows: An incision was made from just in front of the opening of the auricular canal forward two inches along the malar bone (Fig. 11). Then another was made at right angles with the first, extending downward sufficiently to go well below the maxillary articulation. A flap was then dissected up and the joint uncovered, care being taken to retract the facial nerve and the parotid gland with Stenson's duct downward, and the external carotid artery backward.

It was found on uncovering the joint that all semblance of a joint cavity had disappeared, the synovial membrane having been

converted into a membrano-cartilaginous growth by some inflammatory process, so that the only motion to be had was what the bending of this ligamentous attachment between the two bones would admit of.

There were also present two other elements in the immobility of the joint: an overlapping of the head of the inferior maxillary bone by the malar bone, due to the arrested growth of the inferior maxilla, and a tonic contracture of the temporal muscle from long-continued lack of use. In order to overcome the ankylosis, the part of the malar bone overlapping the joint and against which the head of the lower maxilla must strike when the mouth was opened, was chiseled away. The coronoid process was cut across with a chisel below the attachment of the temporal muscle. The head of the bone was then chiseled off in the following manner: The ligamentous band which had once been the synovial membrane was cut through from without inward. A bevel was then taken off the bone from without inward, beginning three-fourths of an inch below the joint and going inward and upward so that the outer three-fourths of the head of the bone was cut away. This was done for the reason that when a ligamentous union again took place between the upper and lower jaws the ligament would be so narrow as to be easily bent; which was found later to be the case.

In leaving the inner point of the head of the bone there was no shortening of the ramus, and the attachments of the pterygoid muscles on the inner aspect of the ramus were undisturbed. The result in this case may be seen by a comparison of the two pictures, one (Fig. 10) showing the extent to which the mouth could be opened before, and the other (Fig. 12) after the operation.

This operation is preferable to that of cutting across the ramus and making a false joint lower down, for the reasons that there is no deformity, there is natural motion even though the joint is ligamentous (the ligament being rendered so narrow by reason of the removal of all but a little of the articulating surface that it easily bends), and also for the further reason that the opening power which is vested in the pterygoid muscles is unimpaired, which is not the case when the ramus is cut across lower down.

Another very serious objection to the resection of the jaw is the unnatural appearance of the patient when attempting to masticate

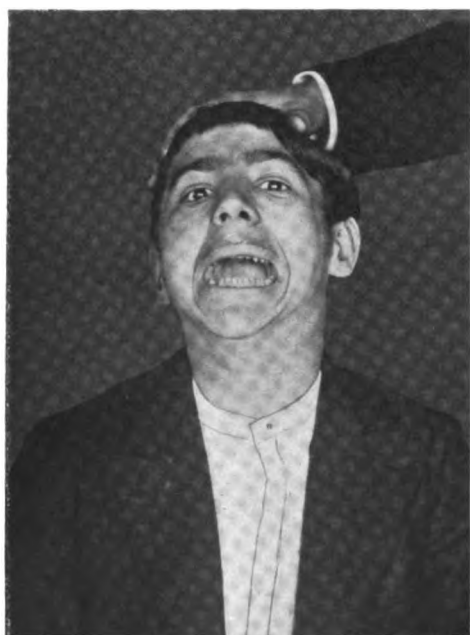


FIG. 12.—After the operation.



his food, the motion, very imperfect at best, taking place from the point of resection and not from the joint as in the operation here shown, the former being a very awkward motion, the latter a very natural one. This patient by this operation was enabled to take his food naturally, and, as a consequence, has gained in strength and weight to such a degree that from a frail-looking boy he has become robust looking, and from being able to earn only boy's wages he is now doing the work of a man.

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## VESICAL TUMORS

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BILROTH, in 1874, removed a tumor from the bladder by the suprapubic route, and then performed the first operation for this disease. Albarran, in 1892, and Clado, in 1895, published works upon the subject which drew the attention of the profession to the importance of vesical tumors and placed the subject upon a rational footing. They were each able to collate a large number of instances of the disease, and emphasized the fact that this was due to the increased facility of diagnosis by the introduction of cystoscopy. In the last fifteen years upward of 700 cases of operation upon tumors of the bladder have been reported, and individual surgeons have reported as many as 100 cases. Indeed, Nitze has observed as many as 399 cases. No doubt he has had very special opportunities, but the fact that so many have been seen by one surgeon implies that the affection is very far from uncommon. I have myself seen upward of fifty cases.

Various classifications have been given, but that of Albarran is thought by many to be the most rational. It is unnecessary to give it in detail, but he recognizes in particular papillomas and carcinomas, adenomas and sarcomas, and some rarer forms which have only occasionally been met with, such as myomas and angiomas. Hitherto surgeons have generally believed malign tumors to be more common than benign growths, and statistics seem to corroborate this view. Thus, Dr. Watson, of Boston, in 653 cases which he has collected, in which operation had been resorted to, found that 243 were benign, while 410 were malign. Of the benign, 203 were papillomas; of the malign, 358 were carcinomas and 52 sarcomas.

Rafin, in cases communicated to him by individual surgeons, reports: benign, 133 cases; malign, 146 cases.

Nitze's cases, reported by Weinrich, give benign, 94; malign, 177; and 128 not exactly determined.

With the knowledge of the greater proportion of malign tumors as compared with the benign, naturally we would surmise that operative interference in many instances would be followed by recurrence of the disease, but the statistics of operation, as collected by Dr. Watson,<sup>1</sup> are much worse than the most pessimistic could anticipate. The operative mortality in benign cases was 17 per cent., and in malign 27 per cent. Then in the benign cases which survived there was rapid recurrence in 20.5 per cent., and in the malign in 26.8 per cent.

In the statistics collected by Rafin for the French Urological Association, the results in 146 unpublished cases of carcinomas reported by surgeons were as follows: Ablation of the tumor in 57 cases gave a mortality of 14 per cent., and in the 49 survivors recurrence or death occurred in 28 during the first year. Palliative treatment was adopted in 89 patients, and few of these lived longer than six months.

In the benign cases, 156 suprapubic operations were performed in 133 patients and the mortality was 6, while the later results in 91 cases gave 24 recurrences and 67 cures. Of the 67 cures, 26 were of less than one year's duration.

It must be noted here that even in benign tumors operative interference is very frequently unsuccessful. This is probably in great part owing to the site of the tumor, which in a large percentage of cases is in the lower zone of the bladder near the ureteral openings into the bladder. It has been said that single villous papillomas in over 90 per cent. of cases are situate not only in the above zone but close to one or other ureteral orifice. Multiple growths are irregular in their position but they are almost invariably grouped around the region of the trigone.

It can easily be understood how in this position tumors are difficult to reach, even by suprapubic cystotomy, so as to enable the surgeon to excise them with certainty. Portions may be left behind and recurrence is thus almost certain to take place. This may be so when no infiltration is present and the growth single. Even in a pedunculated tumor, to ascertain, in this position, where the

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<sup>1</sup> *Annals of Surgery*, Dec., 1905.



attachment of the tumor ends, is difficult, and when several growths are present the difficulty is much increased. Fear of injuring the ureter must also be present in the mind of the surgeon and deters him from cutting so freely as he otherwise would do.

Another factor which increases the risk of return is the duration of the tumor since its first appearance. This is not easily estimated accurately, but approximately we can judge from the time when bleeding first occurred, hematuria in the majority of cases being the first symptom of simple fimbriated or warty papillomatous growth. Rafin gives statistics of 174 cases; 75, to judge from the symptoms, had existed one year, while 80 had been present from 2 to 6 years, and the remaining 19 for more than 6 years. It may be argued that long existence would mean slow growth, but on the other hand, that does not imply restriction of the attachment. While the outgrowth of the tumor may remain small, we may have the deeper portion extending more widely. That the tumor will be larger and the risk of multiple growths will be greater *cæteris paribus* the longer the tumor exists is probable, and further, if it be true, as some writers believe, that simple tumors may become malign the longer the tumor be left the greater the risk.

It has been urged that when recurrence takes place after operation upon a fimbriated papilloma the second growth differs in character from the first and bears a close resemblance in its further history to a malign tumor. This has not been my experience. Invariably I have thought delay in growth followed operation even though all of the tumor was not removed.

We cannot change the type of tumor we have to deal with nor can we alter the site which it occupies, but we can lessen, I believe, the duration of its existence, and thereby do much perhaps to improve operative results. Early diagnosis is for this most important, and for its attainment a recognition of the value of cystoscopy is needed. The importance of cystoscopy as a means of diagnosis and prognosis in urinary surgery is now well recognized, but I wish to mention the importance of *its early use* in cases of hematuria, as in those cases due to tumor it means early recognition of the cause. To see a tumor is easy; the examination is not painful as a rule, and can be carried out in the majority of patients without general anesthesia. It is sometimes thought that harm may be

done by such an examination, but with strict attention to aseptic measures there is practically no risk. In certain cases it is better to be prepared to operate at the time of the cystoscopic examination than to delay, but that is not necessary in all cases, and it is infinitely better to recognize the presence of a tumor and operate a few days later than to overlook the disease and allow the tumor to go on growing. Apart, however, from diagnosis, I wish to emphasize the value of cystoscopy in prognosis—a use of cystoscopy in my opinion far too little recognized. It is impossible to overestimate the importance of noting the site and attachment of the growth, whether it be single or multiple, and if possible, by what are now fairly well recognized appearances, whether it be malignant or benign. Is it a case for curative operation, or will the only operation suitable be palliative in its nature? This is a question of the greatest importance, as, if curative operation be impossible, we have most carefully to consider at what period a palliative procedure should be adopted. I have discussed this in a paper recently.<sup>2</sup> The conclusions I have arrived at and stated are: (1) Operation should be delayed, in cases unfavorable for cure, until the symptoms are so severe that the patient's life is rendered very unpleasant and his health is suffering; (2) when sepsis is present and the symptoms aggravated, and the patient suffers from septic absorption, operation is indicated; (3) when hematuria is persistent and the patient is losing ground, operation arrests bleeding and prolongs life. In such cases suprapubic cystoscopy is the best operation. Frequency of micturition is got rid of and the patient gains strength, as his rest at night is less broken. The permanent fistula can have an apparatus so fitted that distress from leakage of urine is almost entirely obviated.

**CANCEROIDAL TUMORS.**—These are infiltrating tumors which invade the bladder wall and tend to ulcerate. They are practically inoperable from the time of the recognition of their presence, as has been pointed out by Guyon and others. Guyon says, "The surgeon always arrives too late." This is not necessarily because the medical attendant has neglected to try to diagnose the condition early. We must recognize that the tumor may have caused the patient so little discomfort that he has not sought advice until

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<sup>2</sup> American Journal of Urology, December, 1905.

graver symptoms supervened, and it was then too late. How often do we see a similar unfortunate condition in tumors of the alimentary tract.

In other cases, however, and the first which I shall describe is a good example, there is much delay in a real attempt at diagnosis.

The symptoms are frequently atypical of bladder tumor and point rather to cystitis or calculus. Pain and frequency of micturition with pus in the urine often constitute the first symptoms. Stone is not infrequently indicated by the passage of calcareous particles with the urine. Hematuria is not uncommon as an early symptom, but now usually makes its appearance after the other symptoms have existed for some time. The patients are generally of middle age, or older, about sixty years of age. The diagnosis may be suggested on examination per rectum when the base of the bladder is felt to be hard and fixed. Cystoscopy in these may be difficult as the patient seeks advice late in the disease, and the bladder may be much contracted.

I have had a number of such cases under my care, and in all the history and symptoms have been very similar. The following patient may be taken as a type:

Mr. C., aged 43 years, first complained of frequency of micturition in 1898. At that time he had no pain and there was no blood in the urine.

1899. Patient had pain during micturition and frequency was great; every two hours night and day. No blood.

1900. In statu quo.

1901. The same symptoms, but more severe.

1902. Symptoms continued, but for the first time there was bleeding.

1903. Symptoms were aggravated, and in May the bleeding was continuous for 14 days. Many clots were passed, chiefly at the end of micturition. He was sent to see me on 23rd of May of this year. Bimanually, there was easily palpable above and to the left of the prostate a hard, firm swelling. This swelling was not irregular in shape.

*Cystoscopy* revealed a large tumor on the left lateral aspect of the bladder, smooth on its surface and non-ulcerated.

*Suprapubic cystotomy* was performed and the tumor was found incorporated with the bladder wall and obviously not removable.

The bleeding entirely ceased for a time after the operation, and the patient's general health was much improved for some weeks. He died in September of the same year.

In this case to attempt curative interference was not justifiable. It would have meant excision of half of the bladder wall, but obviously the tumor was fixed to the parts external to the bladder and removal of all disease was an impossibility.

On the other hand, much relief was given by a palliative procedure. As I have stated, he had temporary relief from all symptoms for a time but died in four months.

Another patient, Mr. S., aged 65, passed blood in December, 1901, but had no other symptoms. For four months bleeding was intermittent, and four months later when I saw him he had great frequency of micturition and was suffering from septic absorption. The urine contained pus and blood. Cystoscopy showed a crateriform ulcerated surface invading the left lateral wall of the bladder. Suprapubic cystotomy was performed as a palliative procedure. Much relief to the symptoms resulted and he greatly improved for some weeks, but died four months later.

Others of the patients who come under this class of tumor improved very markedly after cystotomy, but nearly all died in less than a year after operation.

**PAPILLOMAS.**—In this, the most common form of benign tumor of the bladder, infiltration of the bladder wall is not present, and from the pathologic nature of the growth and its anatomic attachment, successful results should be anticipated from operation; from statistical evidence, however, such success is not even usually obtained. Two varieties of papilloma are recognized: (1) The fimbriated (villous growths) which are not infrequently pedunculated; and (2) warty tumors which are usually sessile, but implanted upon the mucous coat and do not infiltrate the muscular layer.

The symptoms in these varieties are practically identical, and are now well recognized by the profession. Hematuria is almost invariably the first symptom, and has characters which are almost pathognomonic of this disease. It is most important, however, to

remember that in some cases the bleeding does not conform to the typical form and that error may in this way arise. Not infrequently I have known cases missed in which for months, and even longer, the blood was intimately mixed with the urine and was dark in color, giving rise to the belief that the condition was renal.

In all cases, however closely the hematuria may agree with our conception of that due to vesical papilloma, it is necessary to examine the bladder cystoscopically to avoid error. I have known hematuria from a nephroma simulate that of characteristic vesical tumor hematuria so closely that, no renal tumor being palpable, the diagnosis of vesical tumor was only avoided by cystoscopy. The reverse, also holds, but as a rule we see hematuria which simulates renal bleeding in ulcerated carcinomas rather than in papillomas.

Prostatic bleeding may readily give rise to the idea of vesical tumor and *vice versa*. In one case in which vastomy for enlarged prostate had been performed, cystoscopy showed the presence of a well-marked pedunculated papilloma in a man 65 years of age.

To illustrate the history of a more or less typical case of papilloma, I may give the history of Mr. I., aged 35 years, who first noticed blood in the urine one year before I saw him. There was no cause for it and he had no other symptom. The bleeding was intermittent and the blood, bright red in color, came chiefly at the end of micturition. Cystoscopy revealed a sessile tumor about the size of a walnut with short villi situate on the right lateral aspect of the bladder immediately above the ureter. Through a suprapubic wound the tumor was removed by clipping it away along with the mucous membrane of the bladder and some muscle fibers. Microscopically it was a papilloma.

The operation was performed in 1898, and from then until now he has never had a symptom to indicate recurrence.

The following case is a very typical instance:

Mr. B., aged 43 years, first noticed bleeding in 1898. It came on without any known cause and lasted two days. There was no further bleeding for two or three years and then from time to time he had slight bleeding without any other symptom. In January, 1905, there was great hemorrhage, and since then until the end of February the urine had never been free from blood. No other

symptom had supervened. He had not had retention and the urine contained no pus.

*Cystoscopy:* Two villous tumors, one on each side of the trigone. These were removed through a suprapubic opening and at the present date, June, 1906, eighteen months after the operation, the patient is perfectly well.

Microscopically the tumor was a characteristic villous papilloma.

Other patients with similar histories and with tumors of a similar kind have been operated upon by me. In some whom I have been able to follow up no recurrence has taken place, but in others, as far as I can estimate about equal in number, recurrence has followed operation. In these I have observed at the time of operation two facts: First, the tumors have been attached to the bladder wall more widely and the actual base of the tumor has been less definitely delimited than in the others. Second, these tumors have been situate, almost invariably, nearer the urethra—along, I might say, the trigone between the ureteral opening and the urethra.

In two of the cases the tumors have been multiple, which, as Nitze has said, shows at the outset a tendency to reproduction.

One of these patients seems to bear out my contention that the duration of the disease may have a deleterious influence upon operation.

J. B., aged 45 years, for four years before he came under my care, had intermittent hematuria. Renal calculus was suspected, and two years previously the right kidney was cut down upon but no stone found. The bleeding continued and increased in quantity. There was some frequency of micturition, but this seemed associated with the presence of clots. Cystoscopy revealed a villous tumor growing from close to the urethral orifice and extending on to the anterior aspect of the bladder wall. It was sessile, and a smaller one was attached close to it. *Operation:* Suprapubic cystotomy. The tumors were as seen cystoscopically except that the second was more extensive than I had supposed. Complete removal was difficult and I was not satisfied that I succeeded. Hematuria recurred in nine months. Cystoscopy showed that the tumors had recurred and seemed more extensively to implicate the bladder wall. I advised no operation then, but said that later a palliative cystot-

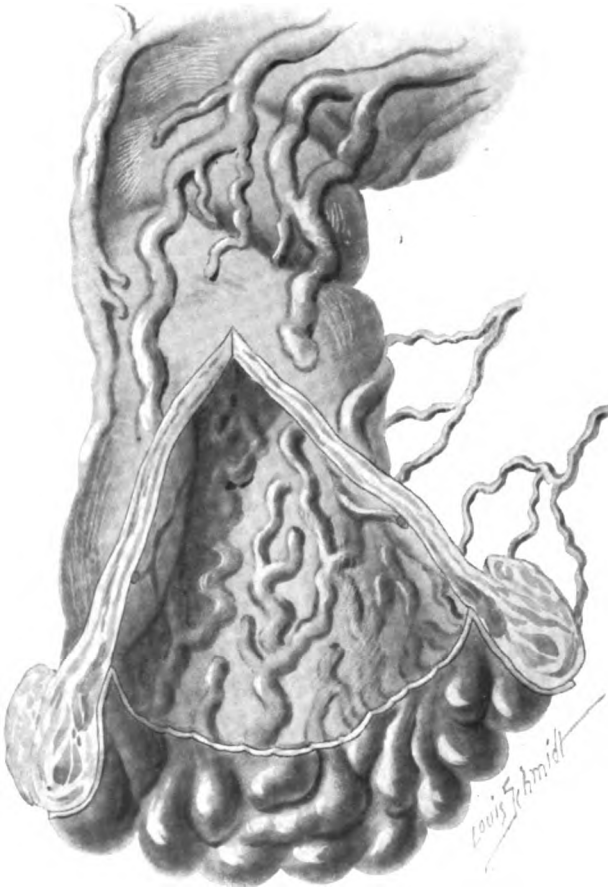
omy should be done, and three months later this was required. The tumors were typical fimbriated papillomas.

I believe that if we saw our cases of bladder tumors earlier, operative interference would more likely be successful and that much suffering would be prevented and some lives saved. I admit the difficulty in removing the disease thoroughly because of the site so commonly occupied by these tumors, but I think with very free opening of the bladder so that good access is got and the attachment of the tumor is seen and not merely felt, we should be able to remove it completely. Trendelenburg's position and Petersen's bag in the rectum should be adopted. A head lamp to throw the light into the comparatively deep wound is most advantageous. In these cases it is not an immediate bad result we have to fear, it is recurrence from incomplete removal so that the remote result is bad. Bleeding at the time can be readily controlled. That success, however, also in great part depends upon the patient being treated at an early period in the life history of the tumor seems self evident. For the diagnosis to be made early, cystoscopic examination should be resorted to at once in all cases of bleeding from the bladder in which no satisfactory explanation of the bleeding can be otherwise arrived at.

When the importance of this is recognised and the harmlessness of cystoscopic examination, properly conducted, is appreciated, I believe the result of operation upon at least simple tumors of the bladder will be much more satisfactory than at present, and the heroic procedure of completely excising the bladder after a double nephrostomy and permanent drainage of the kidneys through the loins, suggested by Dr. Francis Watson,<sup>3</sup> will be relegated to the limbo of the "have beens."

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<sup>3</sup> *Annals of Surgery*, December, 1905.



**FIG. 1.**—The veins about the anus and the lower portion of the rectum. The superior veins arise in tufts or clusters beneath the mucous membrane and, passing upward, pierce the muscular coat of the rectum about four or five inches above the anus.





## THE TREATMENT OF HEMORRHOIDS

BY GEORGE P. MÜLLER, M.D.

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THE veins returning from the anus and lower portion of the rectum are very numerous and anastomose freely, forming a mesh-work known as the hemorrhoidal plexus (Fig. 1), which is usually divided into a superior, a middle, and an inferior zone.

The superior veins arise in tufts or clusters beneath the mucous membrane and, passing upward, pierce the muscular coat of the rectum about 4 or 5 inches above the anus, unite and form the superior hemorrhoidal vein which terminates in the portal system.

The middle plexus is mostly external to the rectum and anastomoses but slightly with the other two; it communicates with the prostatic plexus in the male and with the vaginal plexus in the female.

The inferior plexus receives the venous blood below Hilton's white line and is found subcutaneously about the anus; its trunks mostly pass into the ischio-rectal fossa and terminate in the internal pudic vein in Alcock's canal. A number of small veins arising beneath the muco-cutaneous tissue do not pass into this plexus but find their way upward and become part of the superior hemorrhoidal plexus.

When these veins become altered or varicosed and cause certain symptoms they are termed hemorrhoids (Greek, *a flow of blood*) or, more popularly, piles (Latin, *a swelling*).

The cause of hemorrhoids is hard to find, but the many conditions to which their occurrence has been ascribed can be grouped into two classes: pressure, and local inflammation with thrombosis. Among the former, straining at stool, constipation, pregnancy and visceral lesions affecting the return of venous blood are the most frequently met antecedent supposed causes. As most adults experi-

ence at some time one of the varieties of hemorrhoids, and as the above conditions are so common, it is useless to enter into controversy as to the probable cause except to draw attention to them as causes to be removed, if possible, before undertaking radical treatment.

Enlarged prostate and stricture of the urethra lead to engorgement of the hemorrhoidal veins by reason of straining; constipation is a potent cause, not only producing straining at stool but causing direct pressure upon the venous trunks. Cirrhosis of the liver, theoretically should always be accompanied by piles, but actually they are rarely observed, a fact noted and commented upon by such eminent observers as Nothnagel, Frerichs, Sappey, etc., and some writers have urged that it is dangerous to attempt a cure of hemorrhoids due to liver cirrhosis.

Recently, Reinbach objects not only to cirrhosis of the liver but also to constipation as a cause, basing his statements upon cases observed in children and in those without sluggishness of the bowels. He considers a hemorrhoid as a new growth.

Piles, however, are rare in children, Kelsey having observed but 2 instances, and Goodsall and Miles in a large series the same number. Reinbach reported 4, the youngest subject being only seven weeks old. Tuttle has observed only 3 instances, but says that Trunka reported 39 children below the age of fifteen years who were affected with hemorrhoids; 75 to 80 per cent. are observed in males and by far the greatest number in middle life, averaging about forty years.

Since the time of Hippocrates hemorrhoids have been divided into the external and internal varieties, and while most recent writers state that no sharp line can be drawn between them, yet the division is sufficiently accurate for clinical purposes if not anatomically.

#### EXTERNAL PILES

External piles are essentially caused by sudden strains rupturing one of the venous radicles (*venous pile*) or by constipation, the large fecal mass distending and stretching the skin margin which after a time becomes thrown into redundant folds (*cutaneous pile*). A *varicose* and sometimes *thrombotic* plexus is also considered an external hemorrhoid.

**VARICOSE PILES.**—While I believe that an “aneurysmal dilatation,” or some other alteration, such as an endophlebitis, must precede the clinical appearance of the hemorrhoid, the very frequent history of a sudden, painful swelling occurring after straining at stool, lifting a heavy weight, etc., is best explained by the rupture of the varicose vein and the escape of blood into the surrounding subcutaneous tissue, where it becomes surrounded by an adventitious sac. In many cases, of course, the clot may be found in the diseased vessel, which is varicose and otherwise altered by disease. These thrombi or blood collections, if untreated, may become infected, suppurate, and discharge externally, or they may be absorbed and the fold of skin remain as a cutaneous tag. Marginal abscesses with fistulæ have originated from the burrowing upward of pus from an infected external pile which opens into the rectum somewhat above the external sphincter.

In appearance venous piles are simple or multiple, bluish, oval, tense masses, sometimes freely movable, sometimes adherent, and sometimes disappearing upon pressure. They cause intense pain, or discomfort, aggravated by defecation, and prevent the patient from keeping still, whether sitting or standing.

*Treatment.*—Venous piles are usually so easily cured by radical treatment that it seems superfluous to describe any other. They can be operated upon in the physician's office and do not prevent the patient from continuing his business. There are two methods in common use—the simple incision, and excision. The patient may be placed upon the office table in any position which affords the best view of the pile, and the anal region washed with tincture of green soap, boiled water and 2 per cent. creolin solution. Shaving is not necessary. The skin over the pile should be lightly touched with pure carbolic acid applied with a toothpick as a narrow line and then anesthetized with a 2 per cent. solution of cocain or eucain injected by means of a hypodermic needle. In a few minutes anesthesia is complete and by a simple incision the pile can be opened, the clot turned out with a small curette but not squeezed and the cavity packed with gauze. If the pile is of any size it is best transfixed with a curved bistoury in a direction corresponding with the radiating anal skin folds and from within outward. An iodoform suppository (10 grains) should be inserted

into the rectum and a small pad placed against the wound; over this a larger pad and a T-bandage should be firmly fastened. Pain rarely follows; when it does it is best relieved by a hot water bag well protected with flannel to prevent burning the skin of the buttocks. Incision may be followed by the persistence of tags of skin which might subsequently become edematous and painful, and therefore excision is often advised by proctologists. The pile is grasped by a pair of "catch forceps," part of the Allis outfit, and simply cut off with scissors curved on the flat. Bleeding is rarely marked after this operation unless much cocain is used, and can be checked by pressure with gauze or cotton. The treatment otherwise is the same as for incision. I do not like the use of sterile water as advised by Gant for anesthesia, as much more solution is required and I believe the oozing is somewhat greater. These patients should return daily for dressing and the wound cleansed with a 2 per cent. creolin solution and the packing dispensed with in two or three days. In about a week or ten days later the patient will be cured; care must be exercised during the first week that the wound heals from the bottom up and does not "pocket," leading to small fistula formation.

If the patient is willing and the operator has a nitrous oxide gas apparatus and assistance, preliminary divulsion of the sphincter followed by the evacuation of the blood clot offers a greater percentage of primary cures, because in many cases an irritable sphincteric muscle, producing congestion, is at the bottom of the trouble. The muscle should be slowly but well stretched and the attendant soreness relieved by gauze compresses wrung out of hot water.

**CUTANEOUS PILES** (Fig. 2) are simply hypertrophies of the peri-anal folds and are more properly termed connective-tissue hemorrhoids, because the increase in size is due to a thickening of the tissue between the skin and mucous membrane. They are usually sessile and frequently become infected and inflamed, losing their elasticity and standing out prominently as edematous, painful ridges. Microscopically the papillæ of both skin and mucous membrane are observed as short and broad, with a round-cell infiltration in the corium, proliferation of the connective tissue, and a few capillaries, but rarely any veins. When associated with ulceration or stricture of the rectum they are said to be corroborative of syphilis. As has been said, they are usually caused by chronic constipation,

but may also be caused by fissure or follow thrombosed external venous piles. In young boys Tuttle suggests that their presence might be due to the congestion or hyperemia produced by phimosis (causing straining) or sexual excitement.

*Treatment.*—The cause must be removed, with especial care directed to the removal of constipation. If they do not annoy the patient no treatment is necessary beyond the application of zinc oxide ointment at bedtime after gentle cleansing. If edematous and painful they must be removed under cocain by clipping them off with curved scissors and treating the resultant granulating wound. If extensive and if the base is broad they may need to be dissected off and the wound closed by suture, but care must be taken not to remove so much of the muco-cutaneous tissue as to produce an anal stricture; indeed, for this reason, it may be necessary to perform the operation at several sittings.

VARICOSE EXTERNAL HEMORRHOIDS are especially noticeable during "bearing down" and may disappear when pressure is removed. The patient suffers discomfort during certain positions in sitting. They are often mistaken for internal hemorrhoids. I believe they are mostly varicosities of those peri-anal veins which pass upward to join the superior plexus and are therefore easily compressed by the sphincter muscle; straining at stool is the essential cause. The patient complains of a sense of discomfort and fulness about the anus, especially if he is nervous or hypersensitive, and experiences the feeling at stool as if some of the fecal column was retained within the rectum. After defecation there is often a feeling of nervous irritability and a desire to draw the anus upward. Upon examination the patient should be directed to bear down, when the varicosity is easily seen and felt as a soft, doughy circular mass or, as Tuttle well describes it, "like an inflated rubber pessary covered with skin and muco-cutaneous tissue, with a bluish tinge." When the finger is passed into the rectum the sphincters are felt tightly contracted and the rectum ballooned. Internal piles are sometimes associated and must be recognized.

*Treatment.*—Straining at stool must be avoided by removing the causes thereof; of these, constipation is the most important in adults, phimosis in boys. The diet must be carefully regulated and aperients taken to keep the bowels open, but drastic purgation

must absolutely be avoided. Tuttle advises beginning treatment by the use of an enema of half a pint of cold water at some convenient hour of the day, and after evacuating this without straining and not sitting at stool longer than two or three minutes the patient is instructed to go to his bed, lie down with his hips elevated and apply cold cloths to the anus for five or ten minutes. It is important that this treatment be carried out at exactly the same hour each day. At bedtime some astringent ointment, such as tannic acid, 4 drams; stramonium, 1 ounce; belladonna, 1 ounce (Tuttle) should be applied.

If the patient will consent to the anesthetization the sphincter muscle should always be stretched carefully and yet thoroughly, avoiding the production of fissures. If internal piles are associated an operation based upon those recently advocated by Pilcher and McBurney (described later) will cure both conditions at the same time.

#### INTERNAL PILES

Internal hemorrhoids are usually divided into the varicose, the capillary, the thrombotic and the mixed (interno-external) varieties. Such a classification is often artificial and not of any very great importance clinically. Hamilton has described a variety called "columnar," but these are simply inflamed and hypertrophied folds of mucous membrane and not varicosities of the veins.

If by "thrombotic" we mean the variety analagous to the similar external pile and due to the rupture of a vein and the formation of a more or less localized blood clot, then such an internal hemorrhoid is uncommon. But thrombosis may occur within the vein or veins which are varicosed, and then the latter term alone is used. By mixed hemorrhoids is meant a long standing varicose hemorrhoid which, extending downward, has crossed Hilton's white line and, anastomosing with the external hemorrhoidal plexus, is covered not only with mucous membrane but also with skin; they are globular and rather pale in appearance at their lower portion, pear-shaped and purplish red at the upper, and clinically partake of the characteristics of both internal and external piles.

THE CAPILLARY HEMORRHOID OR NEVOID PILE is due to the

over-development of capillary vessels whereby a small raspberry-like tumor is found, bright red in color, slightly elevated and bleeding freely and easily at the slightest touch. They resemble the capillary nevus in other parts of the body, but are rarely, if ever, found in children. They cannot be protruded by straining and are not perceptible to the finger, the protoscopic examination made to detect the cause of the bleeding being the only sure method of diagnosis.

In the *treatment* of these hemorrhoids two methods are advised, the one most easily performed by most physicians being the application of fuming nitric acid through a conical speculum. The speculum is introduced and the obturator or slide withdrawn until the pile comes into view, when it is dried with cotton on an applicator and the acid applied by means of a glass rod rather pointed and blunt on the end. Care must be exercised that the acid does not run over the normal mucous membrane. In a few minutes a small piece of cotton saturated with a strong solution of bicarbonate of soda should be pressed against the cauterized area and the speculum withdrawn. In order to prevent injury to the anus from acid adhering to the speculum, the anal margin should be greased with boric acid ointment or vaseline before introducing the speculum. Several applications, at intervals of four to six days, are required to effect a cure.

The second, and perhaps the best, method of treatment is the electro-cautery, the speculum being introduced as before and a 10 per cent. solution of cocain lightly applied to the hemorrhoid. A small and, of course, flat cautery is applied to the pile and the current turned on until the growth is burned away, without, however, causing too deep a burn. An opium suppository should be introduced into the rectum after either of these methods of treatment, to insure the comfort of the patient, but backache may be very annoying for several days. A feeling of moisture about the anus may also be experienced for several days but will not require a re-examination of the cauterized area.

VARICOSE INTERNAL HEMORRHOIDS is the most frequent variety of hemorrhoids and, as has been suggested above, has a varied etiology. These piles are varicosities of the veins of the superior hemorrhoidal plexus in the submucous tissue and are situated in the last



two and one-half inches of the rectum. The congeries of veins are arranged in distinct, localized masses, and in number vary from one to seven. The most common pile is situated in the lower right quadrant (patient leaning over a chair) or, to speak in terms of the compass, in the south-east corner of the rectum. With this one a pile at the east and sometimes the north-east position may be coalesced. The west and north-west positions are next in frequency, and the south point is the most rare. Between the prominent tumors there is often a varicose condition of the veins which is of no importance surgically but is often unnecessarily grasped by the clamp and cauterized.

It is not necessary in this paper to review the pathology of these piles beyond stating that they consist of a central artery or several small arteries, a mass of dilated veins and an increased amount of connective tissue which is infiltrated by a serous and cellular exudate. The symptoms are well known; bleeding, pain, mucous discharge, itching, and protrusion of the pile (Fig. 3). In every case a digital examination should be made, not only to ascertain exactly the location of the piles but to exclude other pathologic conditions. I know of one instance in which the symptoms and protrusion of the piles were considered sufficient for a diagnosis, and only at operation, after the sphincter had been stretched, was a cancer of the rectum detected. Among the less marked symptoms are gastro-intestinal disturbances, pain in the legs, constipation (cause and symptom), backache, and often a "sense of impending evil" (Kelsey). Most backaches are due to intestinal indigestion, rectal disease, or disease of the female generative organs. In examining for hemorrhoids the greased finger should be introduced to its fullest length and the upper rectum examined for polyps, cancer, etc., then slowly withdrawn until the middle knuckle is outside the sphincter, when, by sweeping the finger about the bowel, the piles may readily be felt. If the introduction of the finger excites painful spasmodic action of the sphincter muscle a fissure should be suspected and sought. Treatment is palliative or operative.

*Palliative Treatment* should receive the first consideration in the early stages of hemorrhoidal disease, although in so stating I am aware that the general opinion among surgeons and proctologists is in favor of a radical cure in all cases in which the consent of the

patient can be obtained. No operation is without danger and, as is well known, patients afflicted with disease of the rectum frequently require large amounts of ether to obtain anesthesia, the use of cocain or sterile water not being practical for most cases. Hemorrhoids which do not protrude, or which never become caught by the sphincter after the act of defecation, can be cured with persistence of treatment and the coöperation of the patient.

The cause for the varicose veins must, of course, be first removed; urethral stricture, hypertrophy of the prostate, vesical calculus, fibroid of uterus, etc., and especially impaction of feces must be treated, thereby relieving pressure.

Constipation must be vigorously combatted and a daily soft stool ensured by suitable remedies; I usually advise the pill recommended by Tuttle, consisting of a grain each of compound extract of colocynth and extract of cascara, and one-quarter of a grain each of extract of belladonna and extract of nux vomica, giving one or two at bedtime. Saline purgatives are harmful, although phosphate of sodium before breakfast is sometimes very beneficial. Regular exercise, gymnastics, etc., are very useful, but should not be carried out to the point of exhaustion, horseback riding being usually harmful. Alcohol should be interdicted if possible and portal congestion relieved by dietary regulations, exercise, and the cure of constipation.

Hemorrhage is often the only symptom of moment and is alarming to the patient and even provocative of anemia. If the amount of bleeding is great operative treatment should be advised, otherwise local applications may be tried; of these, adrenalin holds the first place and is best given after stool, in a suppository of two drams of the extract of suprarenal and oleum theobromæ; injections of krameria, cold water, or hamamelis. The horizontal position, with the buttocks elevated and pressure applied to the anus, will also arrest bleeding.

Pain is caused by spasm of the sphincter or by the passage of feces over the inflamed pile, and is best relieved by rest in the recumbent position, the application of a lead lotion, hot poultices and even the hypodermic use of morphin. If unrelieved, operation is indicated, because stretching the sphincter will usually require an anesthetic and the pile can be removed at the same time.

*Operative Treatment.*—Eight methods are described in the text books: (1) Crushing, (2) submucous ligation, (3) Whitehead's operation, (4) excision and suture of the wound, (5) ligation, (6) clamp and cautery, (7) injection, and (8) divulsion.

(1) *Crushing.*—This is an old operation revived in 1880 by Pollock and practiced later by Allingham but has never been extensively practiced. It is safe, followed by little pain, and is especially applicable in external hemorrhoids, but has been mostly supplanted by the clamp and cautery. The sphincter is dilated, the crusher applied longitudinally close to the base of the pile and allowed to remain for several minutes.

(2) *Submucous Ligation.*—This method devised by Dr. Merrill Rickets is especially recommended by him in the large single or large multiple pile, but has not found favor because the pain is greater, sloughing may occur, and it is outweighed by the advantages of certain of the other methods. Rickets has recently given his views upon the operation <sup>1</sup> and still advocates its use.

(3) *Whitehead's Operation.*—First described in 1882, this ingenious method has been the subject of much debate relative to its value. The operation is described by Whitehead as follows: "By the aid of scissors and a pair of dissecting forceps the mucous membrane is divided at its junction with the skin around the entire circumference of the bowel, every irregularity of the skin being carefully followed. The external and internal sphincters are then exposed by rapid dissection of the mucous membrane and attached hemorrhoids. Thus separated from the mucous bed upon which they rested, they are pulled bodily down, any undivided points of resistance being snipped, and the hemorrhoids brought below the margin of the skin. The mucous membrane above the hemorrhoids is now divided transversely in successive stages, and the free margin of the severed membrane above is attached, as soon as divided, to the free margin below by a suitable number of silk sutures, after the hemorrhage has been arrested by torsion." Various modifications have been suggested, but the nearly general opinion is against the operation. I have performed the operation once with excellent results, but it was long, tedious and very bloody. The long dura-

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<sup>1</sup> Therapeutic Gazette, March 15, 1906, p. 157.



FIG. 2.—(Vulvar) external hemorrhoids.



FIG. 3.—Protruding internal hemorrhoids.

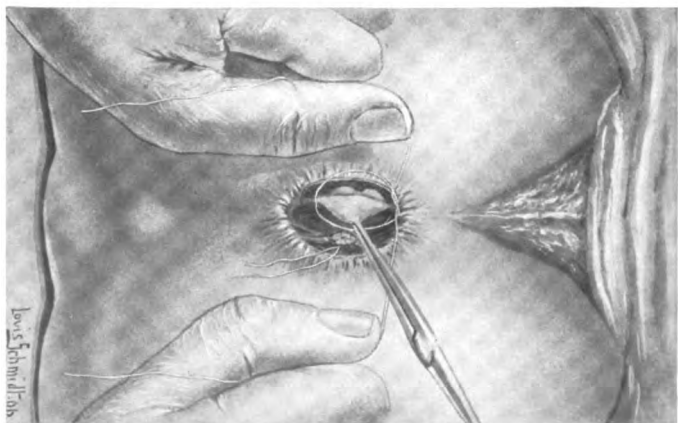
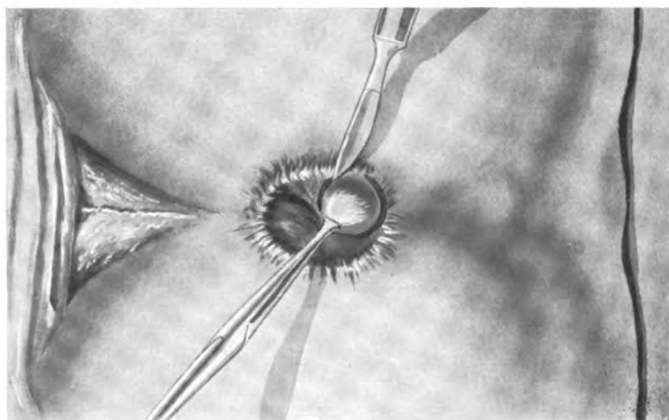
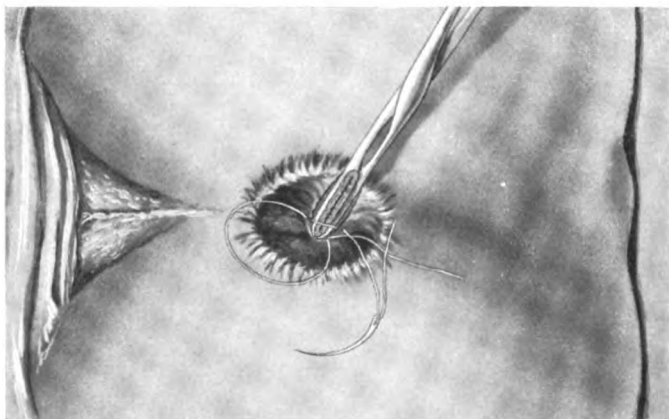
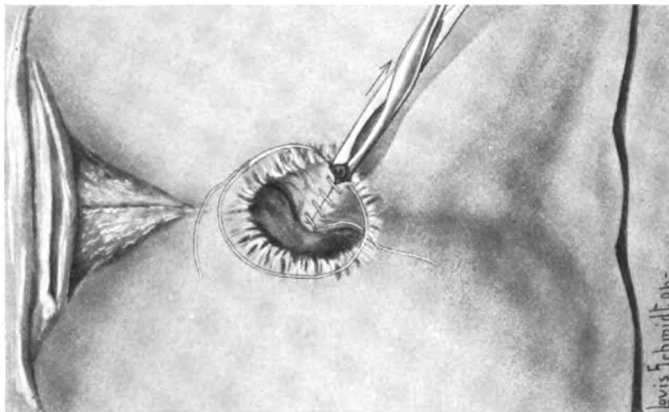


FIG. 4.—Ligature method. The pile has been dissected up and the ligature is being tied.



FIGS. 5, 6, and 7.—Excision by Picher's method. An incision is made through the mucous membrane, on either side of the pile converging below at the mucocutaneous junction; the mass grasped by long forceps and the excess cut off (Fig. 5). A ligature is applied by a needle passing through a fold of the mucous membrane just beyond the clamp, to occlude the vessels (Fig. 6). The long end of the same catgut ligature is used as a running suture (Fig. 7). The clamp is withdrawn and the suture tightened and tied.

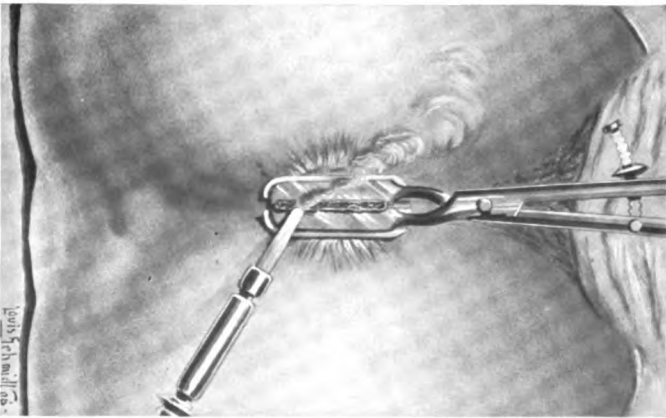
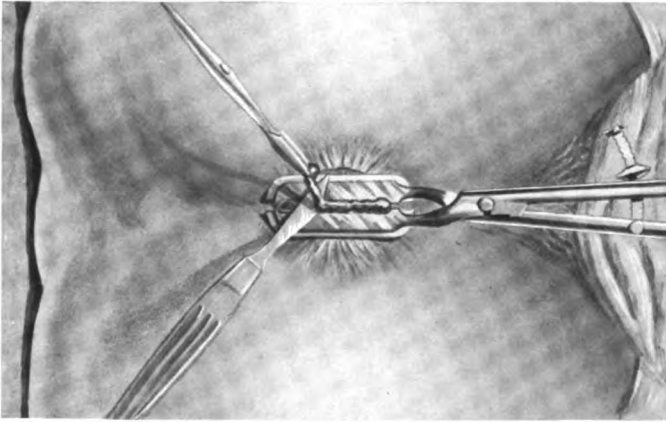
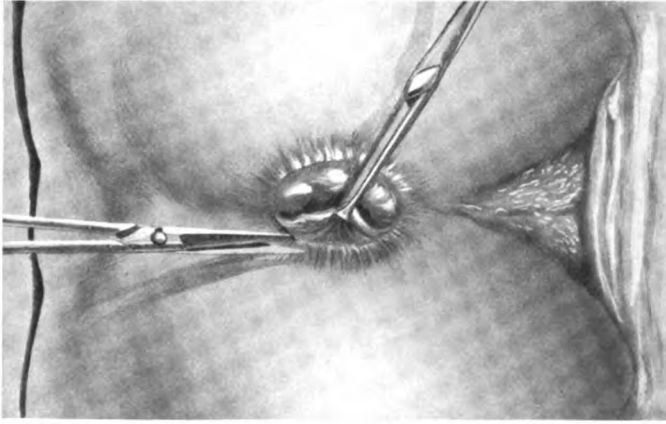
tion in bed, frequent infection, danger of prolapse of the mucous membrane, and especially the loss of the tactile or sensitive margin of the anus are valid objections.

(4) *Excision and Suture of the Wounds*.—There seems to be a tendency in recent literature to advocate such operations as will be surgically complete by closing over the pedicle the sutured mucous membrane. Earle's modification of the Whitehead operation, described in 1896, is, as far as I know, the forerunner of these methods; McBurney and Pilcher (Figs. 5, 6, and 7) have described similar operations. If primary union could always be obtained after operation the method would be ideal, but most operators fail to obtain such a result, the wound becoming infected, breaking down and an ulcer occurs just as in the clamp and cautery method, with the additional disadvantage of the presence of the sutures. McBurney's method appeals more to me than do the others, and he claims that it is safe, radical, and does not produce ulceration or stenosis. His description of the operation is as follows:

"The hemorrhoid to be operated upon is grasped with a tight clamp from side to side, lifted gently from its attached aspect by an assistant, while the operator with a knife (not with scissors) makes an incision on either side of the tumor, parallel with its long axis, through the mucous membrane above, and the skin below. The two incisions should meet at a very acute angle below, and should invade the skin only enough to make this angle and avoid producing an awkward fold or tag. The tumor with the surface included by the incisions is now to be dissected up with the knife or with straight, sharp scissors. This dissection must include the vessels of the hemorrhoid, but no more surrounding tissue than is necessary. The incisions can now be continued upward on either side, always converging to a point just above the hemorrhoid. They need not actually meet. As the tumor is now still further dissected upwards, and as the incisions and plane of dissection converge towards the same point above, the remaining attachment of the tumor is reduced to a small pedicle which, if care has been exercised, will be found to contain the principal artery of supply and emergent veins. At the highest part of this pedicle a catgut ligature is to be tightly tied about it. The hemorrhoid is not yet to be cut away. The long, narrow wound is to be carefully searched, and

every bleeding vessel tied or twisted. Often no ligatures are required; sometimes four or five. No bleeding is to be neglected. The wound must now be very neatly sutured with a continuous suture of No. 1 catgut, beginning at the lower angle. A tenaculum which pulls down the lower angle is of assistance in making the wound edges approximate evenly, and, as one approaches the upper part of the wound, traction upon the hemorrhoid brings the whole wound into view. Sometimes a flat retractor on the opposite side of the anus is needed. The suture is to be continued until the very base of the pedicle is reached and then tied. Now the hemorrhoid may be cut away just below, but not too near the ligature on the pedicle. If a second or third hemorrhoid exists it is to be removed in the same manner, care being taken not to cut into one wound while making the other. As a rule, not more than two good sized hemorrhoids can be removed at one sitting without taking away an undue amount of mucous membrane. When there appears to be the slightest danger of taking away too much tissue, it is much better to postpone further operation until the patient has completely recovered from what has been already done. When the time comes to make a second thorough examination one will usually be surprised to find a complete absence of the tissue upon which a second operation was planned."

(5) *Ligature*.—This is the oldest method of treatment for hemorrhoids and has been advocated since Hippocrates by many of the well-known surgeons—Celsus, Rhazes, Galen, Cooper, Cripps, Syme, Allingham, Mathews, Agnew, Gross, and many others. It is a very simple operation under general anesthesia and consists in divulsing the sphincter, seizing the pile with forceps and making an incision at its base and exactly at the muco-cutaneous junction (Fig. 4). The pile is dissected from the submucous and muscular tissues, and a strong silk ligature thrown around its base and tied tightly close to the rectal wall; the protruding pile is cut off with scissors curved on the flat. The results of this or of Mathew's method have been so good in the hands of so many surgeons that criticism is hardly warranted, but it must be admitted that most patients suffer from great pain and that in many cases the stump fails to separate and must be subsequently treated. It offers no advantages over the clamp and cautery and I believe is



**Figs. 8, 9 and 10—Clamp and cautery method. Dissection of the pile; cutting off the excess of stump; application of the cautery.**





being superseded slowly but surely by the latter, but it is absolutely safe and does cure the disease.

(6) *Clamp and Cautery*.—First suggested by Cusack, of Dublin, in 1846, this method of operating which combines crushing, excision and cauterization of the stump, has deservedly become very popular. There is little after pain, very little danger from hemorrhage, no protracted ulceration and a short confinement to bed. The technic of performance is as follows: (1) The patient prepared and anesthetized is placed in the lithotomy position. (2) The sphincter is slowly dilated and then the hemorrhoids located. (3) One of the masses is grasped with hemorrhoidal forceps and held taut while the operator makes an incision at the muco-cutaneous junction at the base of the pile, carrying the dissection up with straight scissors for about one-quarter of an inch, thus making a groove at the base of the hemorrhoid, this step being essential to prevent pain. (4) The pile is then clamped, the blades fitting into the groove and the screw carefully tightened. (5) The redundant tissue should be cut off, leaving a stump of one-eighth of an inch and the latter lightly curetted. (6) The flat point of a Paquelin cautery is then applied and the stump cauterized until well charred, it being unnecessary to burn the entire stump away. (7) The clamp should be slowly loosened, and if any points bleed it should be tightened and the cautery reapplied. (8) The remaining piles are similarly treated, the stumps returned within the anus and the dressings applied. (Figs. 8, 9, and 10).

(7) *Injection*.—This method of treatment was first advocated I believe by Mitchel, of Clinton, Ill., in 1871, and for many years was used by irregular practitioners and charlatans for the treatment of hemorrhoids with excellent results in the cured cases, but often with sloughing, and a mortality much greater than in the Allingham operation or its modifications. At the present day the method is almost universally condemned by surgeons and proctologists or at most "damned with faint praise" by a few. Kelsey, for instance, in March, 1906, stated that "it fell into disrepute because of its inherent danger and has been practically abandoned by conservative practitioners, though still used by irregular advertisers." I frankly confess never having used this form of treatment, not only because of the general teaching, but also because theo-

retically it seems poor practice deliberately to promote a sub-mucous slough adjacent to a portion of the bowel rich in bacteria.

Recently Dr. C. F. Martin has written enthusiastically of the results attained in a large number of cases by this method, and I quote the following from one of his papers in support of this form of treatment. He first divulses the sphincter muscles under nitrous oxide anesthesia:

"About four days after divulsion, or when the primary soreness has subsided, the treatment by injection may be commenced. I employ a 50 per cent. solution of phenol Bobœuf, injecting from 7 to 10 minims of this solution directly into the center of the pile. The injection is made through a conical speculum, care being taken first to swab off the surface of the pile with an antiseptic solution. The speculum is withdrawn, allowing the rectal walls to collapse, after which the syringe may be removed. After introducing a suppository containing 3 minims of ichthyol the patient is allowed to return to his usual occupation. These suppositories are also used twice daily—one after stool and one at bedtime. Beyond a momentary aching pain and possibly a slight discomfort for an hour or so, the patient experiences no trouble. Occasionally a slough will occur, but aside from a sense of discomfort, there is usually no marked pain, due to the absence of sphincteric irritability obtained by divulsion. From 3 to 12 injections made at intervals of from 2 to 7 days will usually result in a permanent and radical cure. Should a slough occur, it will heal kindly in a short time."

(8) *Divulsion* is especially recommended by some of the French surgeons but has only a limited field of use. Small, painful hemorrhoids, with a spasmodic action of the sphincter can sometimes be cured by divulsion of the sphincter under nitrous oxide anesthesia, especially when followed by cold water injections and dietary regulation.

*Preparation of the Patient Before Operation.*—On the morning of the day before operation the patient should be instructed to take Rochelle or Epsom salts, Apenta or Hunyadi water, etc., before breakfast in sufficient quantity to secure a good evacuation of the bowels. The diet during the day should be light and a quiet night provided for, using trional (15 grains) if necessary. At bedtime the patient should take a warm bath, washing the buttocks

and anal region carefully with soap and water, after which a sterile gauze pad is applied and held in place by a T-bandage. I do not advise an antiseptic dressing nor require the hair to be shaved, unless one of the excision operations is to be performed, provided, of course, the patient is not unusually hairy. Four hours before the time set for operation the rectum should be flushed with a high soap-suds injection which the patient can administer, if necessary, himself, by lying flat in the bath tub or on a bed-pan and by means of a fountain syringe. After this passes the anal region should again be washed. One hour previous to operation a glycerin suppository should be ordered, this usually completely emptying the rectum. No food should be taken for six hours previous to operation, and it is most important that the bladder be emptied before anesthesia is begun. When the patient is placed upon the table the parts are washed with soap and water, the sphincter is divulsed slowly and with the fingers and the lower rectum washed out with a 1 per cent. creolin solution and then dried with gauze. This latter procedure is greatly facilitated by the use of a small Sims speculum. The operation can then be performed.

*After Treatment.*—When the operation is finished a ten-grain iodoform suppository may be introduced into the rectum and the dressing applied. Gauze should be “fluffed up” and packed *tightly* against the anus, filling the ischio-rectal fossa and held firmly by a broad T-bandage. No gauze should be introduced into the rectum. A hypodermic injection of one-quarter grain of morphin should be administered to control pain and the nurse instructed to give water as soon as the effects of the anesthetic have passed away. It must always be remembered that many patients operated upon for hemorrhoids have difficulty in urinating and the operator must provide for catheterization if necessary. This should be done twelve hours after operation, or later if no distress is experienced, and the bladder is not distended; after twenty-four hours male patients can be allowed to stand up to urinate. During the first two days female patients should always be catheterized to avoid soiling the dressings. No food is allowed until the following morning, when, beginning with tea, a soft-boiled egg and toast, a moderately full diet is allowed, avoiding milk, broths and much

liquid, which tend to produce a too early defecation. During this second day I usually give a quarter of a grain of extract of opium in pill form twice. On the afternoon of the day after operation the dressing should be changed and thereafter daily until the bowels move. On the fifth day compound licorice powder or castor oil is given in the morning, and when the desire to move the bowels is felt a soap and water enema must be given and the patient allowed to get up upon the commode or water closet seat. The parts must always be well washed with soap and water and fresh gauze reapplied. The patient may walk around the house after the bowels move and return to business at the end of the week. If the piles are ligatured the patient must be kept in bed until the ligatures separate, usually ten to fourteen days. After excision and suture of the mucous membrane primary union, if it occurs, will do so in seven days, after which time the patient can begin to get out of bed.

*Complications.*—Secondary hemorrhage occurs very rarely and need not be feared at all. It can always be checked by packing the rectum with gauze through a rectal speculum, though one should be ready in case of failure to anesthetize the patient and tie the bleeding vessels. In some of the reported cases the bleeding was not manifest on the dressings and was suspected by the usual pallor, faintness, etc., colicky pains and desire to evacuate the bowels.

Impaction of feces sometimes occurs and results from failure to administer an enema when the bowels desire to move, because the pressure of the fecal column will cause such discomfort that the movement is avoided by the patient. If it occurs some time after operation stricture of the anus should be suspected. Edematous folds of skin are almost always observed at the first dressing, and if fecal impaction is avoided they do not require treatment, but subside at the end of the first week.

Infection of the submucous tissue may cause abscess or fistula, but is uncommon and usually due to a too deep incision at the muco-cutaneous junction of the pile at the time of operation. Such abscesses are usually of the submucous variety, but may extend into the ischio-rectal fossa or upward into the pelvis and cause a fatal pyemia, one of the three causes of death after operation for hemorrhoids—tetanus and hemorrhage being the others.

Stricture of the anus has been recorded as occurring and has been particularly ascribed by some writers to the clamp and cautery method, but it is my belief that faulty technic is responsible for any such complication. If the primary incision is made at the mucocutaneous junction and not out in the sulcus there will be no stricture.

*Choice of Operation.*—In conclusion, it might be stated that a single pile can be easily and safely excised and the mucous membrane sutured; several varicose piles are best treated by the clamp and cautery or, lacking the equipment, by the ligature; hemorrhoids, when hemorrhage has been a pronounced symptom, are best ligated; in all cases of doubt the clamp and cautery should be used. The Whitehead operation is never indicated for hemorrhoids uncomplicated with prolapse; the injection method is dangerous and uncertain; simple divulsion is insufficient. I have not discussed the "office treatment" of hemorrhoids, as I have had no experience in the treatment of internal piles under local anesthesia—for which the reader is referred to the several papers and text-book of Gant.

# Obstetrics and Gynecology

## PLACENTA PRÆVIA AND ITS TREATMENT

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PLACENTA prævia is the development of the placenta wholly or in part in the zone of dilatation of the uterus. Formerly the definition read, the development of the placenta in the lower uterine



FIG. 1.—Frontal and sagittal sections of the uterus. Drawn from plaster casts. (Amer. Text-book of Obstetrics.)

segment, but lately cases of cervical insertion of the placenta have been reported—wherefore, the definition must be extended. In frontal section the uterine cavity is as is pictured in Fig. 1a; in

sagittal section, as in Fig. 1b; and in transverse section, as in Fig. 2. Any portion of the uterus may be the site of the insertion of the ovum, and the placenta will find varying degrees of nutrition and of conditions favorable to growth in proper directions. If the placenta develops in one of the cornua of the uterus it is likely to be placenta circumvallata, and hemorrhage during pregnancy or even abortion may occur. The corresponding portion of the uterus develops more than the rest and a diverticulum may result, giving trouble in the third stage. A placenta circumvallata may develop in any part of the uterus.

If the ovum is attached in the angle at the sides of the uterine cavity, the placenta may be bi-partite, occupying part of the anterior

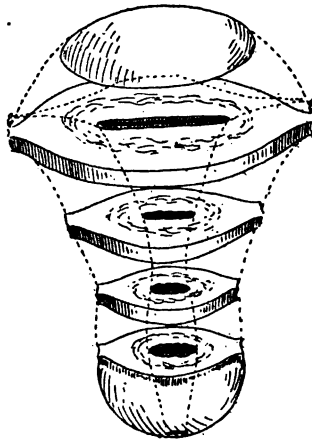


FIG. 2.—Transverse sections of the uterus, showing varying outlines of the uterine cavity at different levels. (Adapted from Williams.)

and posterior walls. The nutrition of the fetus may suffer, but abortion is rare. The lateral portion of the uterus may bulge out in such cases, giving the organ an unsymmetric form. This has been called angular pregnancy, "*grossesse angulaire*," and may lead to diagnostic errors, especially confusion with ectopic gestation.

Fundal insertion of the ovum is the rarest of all, though many text-books illustrate such a location of the placenta. The normal placenta is found on either the anterior or posterior wall of the uterus, with its lower edge at least 10 centimeters from the level of the internal os.

When the placenta is situated so that its inferior border is just



above the internal os we speak of a low insertion. Such a position of the placenta exposes it to danger of partial separation in the process of natural formation of the lower uterine segment either late in pregnancy or as labor goes on, and hemorrhage results. If the membranes rupture early or are artificially broken the placenta can retract with the uterine wall, further separation is avoided and the bleeding is permanently checked. If the membranes are tough and the condition not recognized, thus delaying interference, the placenta may be completely separated from the uterus, dragged down by the advancing membranes, and severe hemorrhage with death of the child occur. Without doubt many stillbirths are the result of this condition.

When the placenta is situated with any portion over the internal os we speak of placenta prævia. It is difficult to designate the degrees of placenta prævia, that is, the extent to which the placenta bridges over the internal os, because the edge of the organ will lie varyingly distant from the opposite wall of the cervix, depending on the degree of dilatation of the os. For example, a placenta completely covering the internal os at the beginning of labor, and therefore called placenta prævia centralis or totalis, may at complete dilatation cover only half of the area, having become a placenta prævia partialis or lateralis. Again, a placenta whose edge was just palpable inside the closed internal os, may, as dilatation progresses, present more of its surface to the examining finger. It would be called placenta prævia marginalis in the first instance, and partialis or lateralis when it was found to cover half the area of the dilating os.

Remembering, then, that the terms are only relative, we divide the cases into three forms, placenta prævia marginalis (Fig. 3); placenta prævia partialis or lateralis (Fig. 4); and placenta prævia centralis or totalis (Fig. 5). Some authors use only the two latter divisions. Clinically the cases are numerous in which just the lower edge of the placenta may be felt inside the cervix, and since its treatment differs somewhat from that of the other two varieties of placenta prævia it has been thought best to retain this classification.

#### ANATOMY OF PLACENTA PRÆVIA

How can the placenta develop so that it covers the internal os? It is easy to explain a low implantation of the placenta by assum-

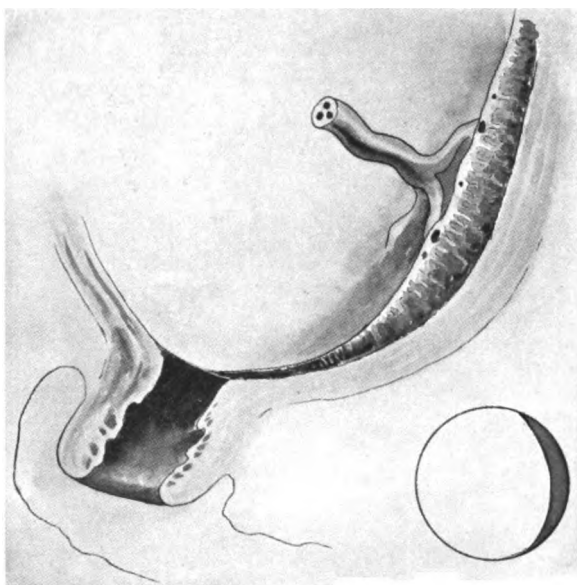


FIG. 3.—Placenta previa marginalis. The edge of the placenta is palpable just inside the internal os.

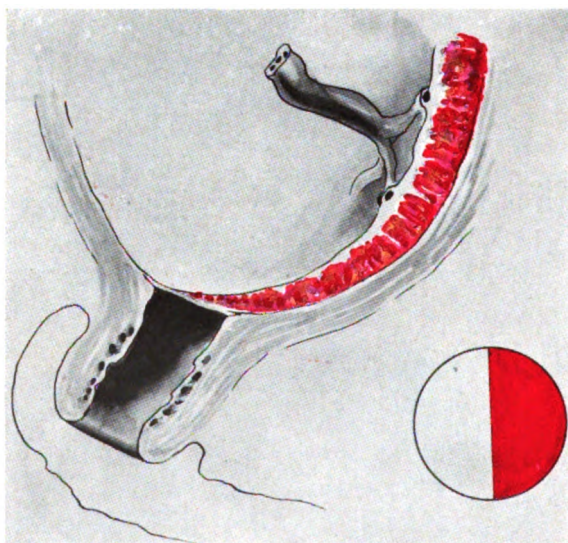


FIG. 1.—Placenta prævia partialis or lateralis. One half, or a little more, of the internal os is covered by placenta.

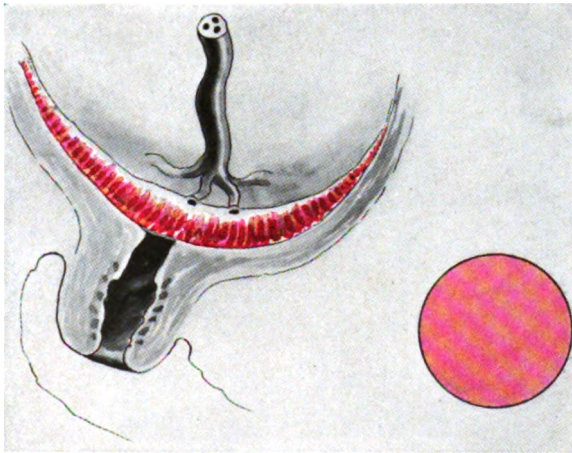
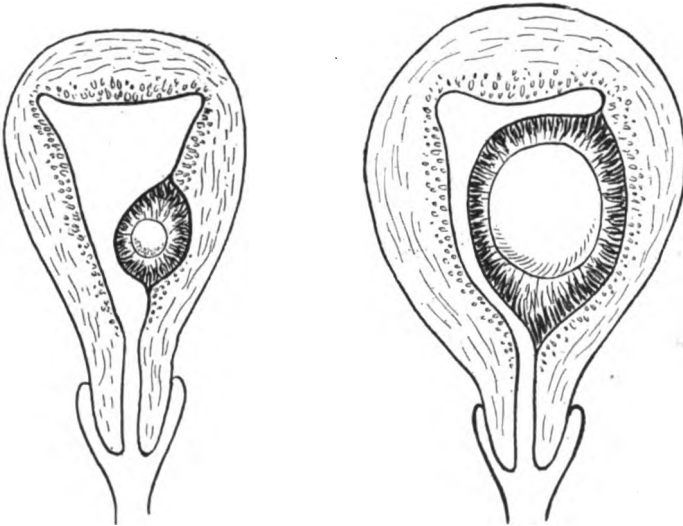


FIG. 5.—Placenta *previa totalis* or *centralis*. The palpating finger feels the placenta completely occluding the internal os. The placenta, however, is seldom situated so centrally as in the illustration.



ing that the fertilized ovum attaches itself low in the uterus. To explain all cases of placenta prævia it is necessary to assume, with Ahlfeld, that the ovulum is not arrested until it reaches the neighborhood of the internal os. The oldest notion of the implantation of the ovum, that of William Hunter, was that the ovum coming down through the tube pushed the decidua ahead of it, being in this manner covered in. The generally accepted explanation, up to within a few years, was that the ovum attached itself to the thickened endometrium, or was caught in a fold, the villi burrowed into the mucosa, which so irritated the surrounding tissue that it hypertrophied, wall-like, around the tiny ovum, finally covering it



FIGS. 6 and 7.—Hofmeyer's conception of the splitting of decidua by the growing ovum.

in entirely. Von Spee, Opitz, and Peters, very recently, by experiments on animals, and by some fortunate finds of very early human embryos, have proved a slightly different mode of implantation of the ovum. According to their findings the ovum eats a way into the endometrium and sinks itself more or less deeply toward the musculature. As the ovum at this period is only 1.5 to 2 mm. in diameter the opening in the epithelium will soon close, or; since the ovum grows rapidly, and all the tissues around hypertrophy, this opening, covered by a blood clot, becomes negligible. The site of insertion of the ovum is the site of insertion of the placenta. It is

not probable that the uterus enlarges at this site to the extent required by the mature placenta. Much deformity of the uterus would result. Some moderate development of the uterine wall at the placental site is generally admitted. The placenta must therefore grow in the flat, and this growth in the flat is permitted, according to Hofmeier, by a splitting of the decidua (Figs. 6 and 7). The limit of the expansion of the placental site will depend on the necessities of the nutrition of the ovum, on the location of the placental site, and on the condition of health of the decidua. A diseased decidua will place limitations on the growth of the placenta, either as regards its size, or shape, or structure. Endometritis thus explains many anomalies of the placenta. It is one of the most common causes of placenta prævia. Subinvolution is

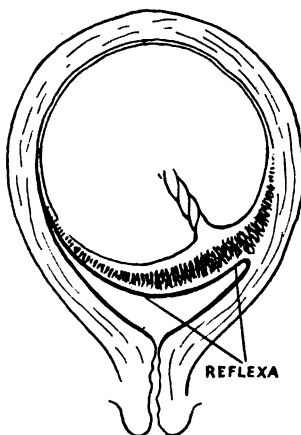
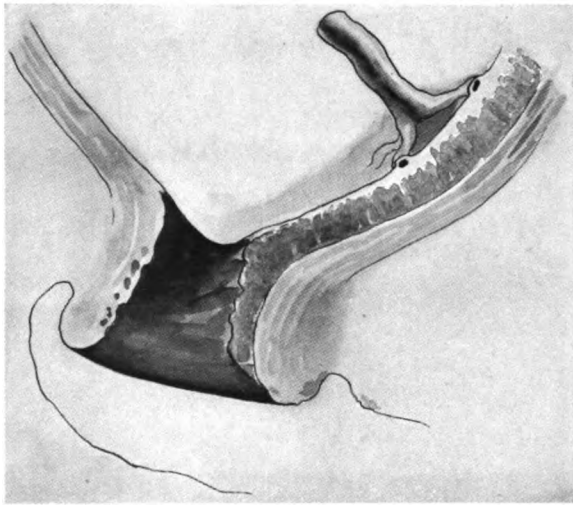


FIG. 8.—Hofmeier's conception of the formation of placenta reflexa.

another predisposing cause, and also multiparity, both leaving a large patulous uterus. It has been observed that placenta prævia has frequently occurred in multiparæ advanced in age who have been sterile for several years. Women who have had post-partum hemorrhage or placenta prævia before, are liable to recurrences, due to the endometritis.

How the placenta grows over the internal os has given rise to much speculation. All investigators agree that the ovum must insert low in the uterus. Hofmeier says the placenta develops in the decidua reflexa, which, as the ovum enlarges, comes to lie over the



**FIG. 9.**—Placenta previa cervicalis (personal observation). The placenta was so adherent to the cervix that it had to be detached forcibly with the fingers.





internal os (Fig. 8). Specimens are preserved which show that the placental villi can and do develop in the decidua reflexa, and that this portion of the periphery of the ovum can later be applied to the decidua vera around the internal os, bridging over the latter, is entirely possible. Whether a real fusion of the deciduæ results, establishing communication between the placenta reflexa and the maternal sinuses, may be questioned. Probably the two simply are applied to each other. Hemorrhage in such cases ought to be small, and it would come from the attached margin of serotina.

Another theory is that the ovum attaching itself near the internal os, raises the epithelium of this side of the cervix against that of the other side of the cervix. Pressure necrosis occurs, the decidua capsularis (Peters) grows into the connective tissue spaces and thus the villi may grow over to the opposite side also. This is entirely analogous to a process occurring in the Fallopian tube in tubal pregnancy. Another possibility is that the placental villi split the decidua circularly, around the os. After the os is encircled by villi their growth over the narrow space is easily understood. In fact, many cases of placenta prævia show a horseshoe-shaped placenta, encircling the os. In very rare instances the villi take a downward course, burrowing toward the external os, sometimes reaching its very edge. In these cases of "cervix placenta" the union of placenta and cervix is very intimate, and usually requires interference in the third stage. I have one case of cervical placenta (Fig. 9). Other cases are reported by Ahlfeld and Wyder. The existence of decidua in the cervical mucous membrane and of cervical placenta prævia was denied until very recently.

The frequency of placenta prævia has been variously given. Schauta<sup>1</sup> says it occurs once in 500 or 600 cases. The statistics are absolutely unreliable. These patients go to the maternities, which increases their percentage.

#### SYMPTOMS

The external evidences of placenta prævia are variable, depending on the depth of insertion of the placenta, the shape of the organ, and other conditions whose influence we cannot so readily understand, as multiparity, blood dyscrasia, etc. The most constant and

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<sup>1</sup> Ges. Gynäkologie, 1905.

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most prominent symptom is hemorrhage. The bleeding occurs in the last three months of pregnancy (84 per cent. of cases, Doranth) and any "painless, causeless, uterine hemorrhage" in this trimester should be taken as almost pathognomonic of placenta prævia. It has been said that early abortion is frequently due to this abnormal implantation of the placenta. I have had several cases which support this view, while Hofmeier<sup>2</sup> could find none in sixteen years' observation. Several patients with placenta prævia coming for treatment late in pregnancy have noted a slight hemorrhage in the earlier months. As a rule, however, the first hemorrhage begins in the eighth or ninth month. It is usually not severe, and the gravida, after a short rest in bed, resumes her duties. The second hemorrhage follows shortly, is severer and the attention of the physician is always called to it. The bleedings now recur at irregular intervals, without cause, and irrespective of the position of the woman. She may find blood in the vessel while urinating or may wake up to find herself in a small lake of blood. There may be from a few drops to a "flooding" which causes death in a few minutes. While the hemorrhages may cease and the case go on to term without further trouble, such cases are so excessively rare that we do not consider the possibility of such a course in practice. In such cases the previal portion of the placenta becomes infiltrated with organized blood and changed into a hard mass resembling a white infarct.

The usual course is for each succeeding hemorrhage to be more profuse than the last until, if not treated, the patient sinks into a severe grade of anemia. She may recover apparently from the actual hemorrhage, and then die suddenly, either without cause (heart clot?) or from a slight added bleeding. This latter may be the necessary blood loss attending the delivery of the child. I would sound here a warning as to treatment. *Save blood!* We do not know the individual's ability to withstand hemorrhage. We do not know how much she has lost before we have seen her, and we do not know how much she is going to lose before the child and placenta are safely delivered. The recovery from a severe bleeding is not complete during pregnancy. It is only apparently complete. One might say that the blood is patched up. The blood-making

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<sup>2</sup> *Handbuch der Geburtshilfe*, ii. Bd., 2, S. 1235.

organs have done their best and if a new demand is made on them they may prove default, and even if the patient bears the stress of the operative delivery, she will likely die from the effects of an acute or chronic anemia. The worst cases of spanemia in placenta prævia are produced by the continuous but slight dribbling of blood, "*stillicidium sanguinis*," as the blood-forming organs are given no opportunity to recover. This is usually caused by a firm clot lying between the placenta and uterus. When such a case finally goes into labor the patient is in the poorest possible condition for delivery. Since the bleeding is so slight the physician is likely to neglect it, forgetting that the total amount of blood lost may be enormous.

In cases of placenta prævia totalis the hemorrhages usually begin earlier than in the other varieties, though many exceptions to this rule have been noted. In some cases of central placenta prævia the internal os remains closed, and bleeding is absent until labor begins. Such cases are characterized by weak labor pains and are therefore unfavorable. The occupation of the lower uterine segment by the placenta prevents its proper development in the last months of pregnancy, and the presenting part, not pressing on the nerves of the cervix, does not evoke the pains of pregnancy or labor.

In partial placenta prævia the lower uterine segment is usually well developed, the pains of pregnancy are usually present and the cervix is softer and often dilated for two or more fingers when real labor begins. These cases are more favorable in prognosis because easier to treat. In such cases the hemorrhages are always a prominent symptom.

In the intervals between bleedings there may persist a grumous discharge, or the patient may be free from all evidence of trouble. A rare condition, called *stillicidium sanguinis*, already described, may exist between the larger hemorrhages.

The placenta may become detached from the uterus, producing an internal as well as external hemorrhage. This is rarely spontaneous, oftener the result of interference.

We can infer from the amount and frequency of the bleeding the kind of case with which we have to deal. A small bleeding late in pregnancy or even at the beginning of labor usually means a marginal placenta. A profuse hemorrhage with a closed cervix at

this time would point to a central insertion. A profuse flooding at the seventh month would also indicate central insertion. Repeated smaller losses in the seventh, eighth and ninth months usually mean that the *prævia* is partial. Exceptions to these rules are not uncommon. I have encountered severe hemorrhage in a case of *placenta prævia marginalis*, and a mild bleeding in a complete *prævia*. Ahlfeld lost a patient in one profuse hemorrhage and only a small portion of the placenta presented.

The origin of the blood is fourfold: first, the veins of the placental site; second, the inter-villous spaces of the placenta; third, the circular sinus of the placenta; and, fourth, rarely, only as the result of interference, the fetal blood-vessels. The direct cause of the hemorrhage is separation of the placental tissue from its site, due to the development of the lower uterine segment. The growth of the placenta cannot keep pace with the enlargement of this zone of the uterus. The contractions of pregnancy force the ovum down into the lower uterine segment, and since the placenta cannot stretch it is torn from its attachments. In complete *placenta prævia* the development of the lower uterine segment is delayed or prevented and in such cases pregnancy may go to term without hemorrhage.

Other symptoms of *placenta prævia* are both inconstant and equivocal. Such are pain, pressure and throbbing in the lower abdomen, leucorrhea, frequent urination, and "carrying the child differently."

*Placenta prævia* affects the course of pregnancy, labor, and the puerperium. It is generally admitted that many abortions are due to *placenta prævia*. I have, several times, in removing placental fragments, found them situated very near the internal os. The hemorrhages have already been mentioned. Premature rupture of the bag of waters is another symptom of low insertion of the placenta. It occurs more commonly in the marginal variety, and is due to adherence of the membranes to the uterus, the result of catarrhal endometritis. As a consequence, premature delivery is common.

The children in these cases are likely to be small and puny, which partly accounts for the high infantile mortality. In cases in which the placenta is not much infarcted and in which hemor-

rhage is absent until very late in pregnancy, conditions very variable, the child will be well developed. Some authors mention pregnancies going over term in placenta prævia centralis, but I have not met such a case.

During labor the low implantation of such a bulky organ causes many anomalies. Malpresentations and malpositions of the fetus are common. Breech and shoulder presentations are most frequent; delayed engagement of the presenting part, especially if it be the head; abnormalities in rotation of the head; prolapse of the cord; weak labor pains; all these accidents are to be feared in addition to the inevitable hemorrhage, which is more or less severe and dangerous. The placental sinuses being near the external air, air embolism must be reckoned with, and since all manipulations take place on the placental site, sepsis is very easily introduced. One of the greatest dangers in placenta prævia is rupture of the uterus. Ivanoff<sup>3</sup> showed the great frequency of placenta prævia in cases in which the uterus had ruptured.

For the child there are also many fatal conditions. The insertion of the cord being near the os uteri, prolapse is not uncommon, and if the cord does not prolapse, the child in passing may compress the insertion and thus asphyxiate itself. The various operative maneuvers may injure the placenta, opening the villi, thus permitting fetal hemorrhage, or even tearing across a large fetal vessel with more certain death of the child. The whole placenta may be compressed by the child, or it may be wiped off the uterus by the child in its delivery. The infant also suffers from the various operative measures instituted, such as version, forceps, and especially using the body as a tampon to stop hemorrhage, the Braxton Hicks method. In addition to these, the child is often premature and suffers from general debility, often atelectasis pulmonum, and may survive but a few days.

During the third stage of labor the low placenta usually causes trouble. Adhesion to the uterine wall is caused by the endometritis which so commonly is responsible for the low insertion, and in addition the placenta being so near the septic vagina, infection is very likely to creep up to it.

The lower uterine segment has little contractility and therefore

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<sup>3</sup> Ann. de Gyn., 1905.

cannot separate the placenta from itself as does the uterine body, outside of the fact that the inflammatory changes render the separation more difficult. For the same reason hemostasis is not so efficient, it also being dependent on the uterine contractility. The uterine arteries enter the uterus higher up, in the zone of active contraction, and this helps to prevent fatal hemorrhage. Clotting in the sinuses does the rest, unless art has to step in.

No doubt many cases of post-partum hemorrhage in otherwise normal labors are due to low insertion of the placenta. I have noted this point in manual removal of the placenta for hemorrhage in the third stage. Even after the placental delivery, the lax lower uterine segment may bleed, and cases of post-partum hemorrhage with a contracted uterus may be explained by finding a bleeding lower uterine segment.

Pieces of placenta may adhere to the uterine wall, and considerable force may be required for their removal. Occasionally they cannot be removed by the fingers.

During the puerperium the low position of the placenta makes trouble. Sepsis is not uncommon, for reasons already mentioned. The type of infection is usually a metrophlebitis, one of the most fatal forms.

Subinvolution is common and it predisposes to a repetition of the placenta previa. Finally, in the puerperium, the woman has to recover from the more or less profound anemia acquired during her delivery.

#### DIAGNOSIS

This is not always easy. The only positive sign of placenta prævia is the palpation of placental tissue through the dilated os. If the cervix is closed we can only suspect the condition more or less strongly. The peculiar spongy, fibrous feel of placental tissue may be simulated by a firm coagulum, by thick vernix caseosa in matted hair, by a monstrosity with exposed viscera, by a hemorrhage between the membranes, and by thick membranes. The last may indicate a low or nearby insertion of the placenta. The other conditions are at once eliminated when they are thought of.

Bogginess in the vaginal vaults, the sensation of a flat sponge between the finger and the fetal head, pulsating arteries in the fornices, a low so-called (but erroneously) placental souffle, unusual

succulence and vascularity of the parts,—all these are equivocal signs of placenta prævia. A highly placed cervix, and non-engagement of the presenting part are frequently noted in these cases, but are not useful points for the diagnosis.

In palpating a supposed placenta prævia one should do so gently, to avoid further separation or tearing of the organ, and profuse or perhaps fatal hemorrhage. If one suspects a placenta prævia it is wise to prepare for stopping the hemorrhage before the examination is attempted.

In the differential diagnosis we are to discover the cause of the main symptom, hemorrhage. Varices of the vulva, hemorrhoids and other bleedings are easily excluded if searched for. The hemorrhage comes from inside the cervix.

Premature separation of the normally implanted placenta (*abruptio placentæ*), rupture of the uterus in pregnancy and ectopic gestation must always be considered in the diagnosis of placenta prævia. If the *abruptio placentæ* is typical there is little difficulty, as the sudden collapse of the patient, severe symptoms with only moderate external hemorrhage, the pain, rigid uterus, etc., declare the nature of the cause. It must be remembered that a placenta situated low in the uterus without being actually prævia may become partly detached and, the point of bleeding being near the os, the blood escapes readily, not completely separating the placenta, and not increasing intra-uterine tension. For these reasons the shock is absent or moderate. Then, too, in the severest cases of *abruptio placentæ* the placenta may prolapse and come to lie over the internal os, simulating to completeness a *forelying placenta*. The two conditions may co-exist.

The table on page 232 presents the differentiating points.

The diagnosis of ruptured uterus is easily made. It can only be a spontaneous rupture during pregnancy, and the difficulty would lie more with *abruptio* than placenta prævia. The presence of the fetus in the abdominal cavity, the empty uterus, the palpation of the rent, and the symptoms of shock clear up all doubt quickly.

Ectopic gestation likewise would give little trouble if only the possibility is considered. The relatively small and hard uterus alongside an extrauterine tumor, the asymmetry of the mass, the



### ABRUPTIO PLACENTÆ. ACCIDENTAL HEMORRHAGE. PREMATURE DETACHMENT.

#### SYMPTOMS.

1. Sudden, stormy onset, often with vomiting.
2. Pain, often severe, generally referred to placental site.
3. Hemorrhage, either external or internal, or both. Sometimes internal at first, later external.
4. First hemorrhage usually severe, rarely mild.
5. Usually one hemorrhage.
6. Hemorrhage continues after rupture of membranes.
7. Some cause, as violence, often found.
8. Symptoms of anemia and shock denote a severer hemorrhage than amount of blood lost would indicate.
9. Usually fetus dies at once.

#### SIGNS.

1. Abdomen distended, tense and tender.
2. Uterus distended, tense, cannot palpate fetus.
3. Uterus may present localized swelling (hematoma).
4. No signs of fetal life.
5. Vaginally feel no placenta over the os.
6. Bag of waters feels tense.

### PLACENTA PRÆVIA. UNAVOIDABLE HEMORRHAGE.

#### SYMPTOMS.

1. Rather quiet onset.
2. No pain unless uterine contractions begin.
3. Hemorrhage, always external at first.
4. First hemorrhage usually mild, rarely profuse.
5. Several hemorrhages at various times in pregnancy. Rarely single.
6. Hemorrhage ceases after membranes ruptured. This only in marginal prævia and low insertion of placenta, where greatest difficulty arises.
7. Causeless, usually.
8. Symptoms proportionate to blood lost externally.
9. Fetus alive till case advanced.

#### SIGNS.

1. Abdomen as usual at the time of pregnancy.
2. Uterus normal, unless contracting.
3. None.
4. The usual signs of fetal life.
5. Placenta over os.
6. Membranes flaccid.

signs of internal hemorrhage and the usual palpatory findings easily distinguish the two conditions.

#### THE PROGNOSIS OF PLACENTA PRÆVIA

Prognosis depends on the condition of the woman when the diagnosis is first made, the period of pregnancy, the degree of the prævia, that is, how much of the os is covered by placenta, and on the skill and convictions of the accoucheur. If the patient has had frequent hemorrhages and lost much blood naturally the outlook is worse for both mother and babe. For the mother it is bad because she may not survive the necessary, even if slight, loss of blood at the time of delivery, and she is also more subject to sepsis. For the child, the frequent bleedings impair its circulation and nutrition, or the pregnancy is interrupted prematurely.

If an early diagnosis of placenta prævia is made hardly any woman should die and very few infants should be lost.

Regarding the period of pregnancy,—the earlier in gestation the symptoms command treatment the better the prognosis for the mother, and the worse for the child.

In complete placenta prævia the outlook is most gloomy for both mother and child, and when such a case goes on to term, truly it presents a formidable complication. In lateral prævia the condition is not so serious, but bad enough. Usually the pains are good, dilatation is rapid and safe; in other words, treatment is not opposed by untoward conditions. The child also has better prospects.

In marginal placenta prævia the outlook is the best of all, but still exceptions exist that make even this form serious and place it, regarding treatment, in the same class as lateral prævia.

The convictions of the accoucheur have much to do in the prognosis and treatment of placenta prævia. If he is a Catholic he will demand that equal consideration be given the child and mother. In some cases of placenta prævia, *e. g.*, when the mother is in bad condition, it is advisable to use the child as a tampon to stop excessive hemorrhage. Many of the children die when used in this manner. To reduce this infant mortality Cesarean section has been proposed. I have observed that Catholic writers urge this method the most strongly. Next come the surgeons who have little

or no technical obstetric skill. They choose the knife as the easiest and quickest way to terminate a formidable case.

Schroeder, of Berlin, an accoucheur of great skill and a conscientious man, advised us to place the interest of the infant subservient to that of the mother, observing that those who take the opposite course lose a larger number of the mothers and do not save many more children.

We possess means of reducing the infant mortality in such cases without recourse to violent measures. The most valuable is the colpeurynter, but I advise its use only in cases in which the mother is in good condition and in which the attendant has had some experience in the treatment of placenta prævia. When these conditions are not fulfilled, the accoucheur does the best for all concerned when he adopts that method which quickly and certainly places the mother out of immediate danger. Such a method is Braxton Hicks' version. The arguments here are nearly the same as for craniotomy on the living child, and those interested are referred to a paper that I published several years ago.<sup>4</sup>

The maternal mortality of published cases of Cesarean section for placenta prævia is still very high, in spite of the fact that the favorable cases are usually placed in the journals. Still, I believe that there is a place for the abdominal delivery in these cases and will discuss the point under Treatment.

The skill of the physician who happens to get a case of placenta prævia has much to do with the prognosis. In very few places in medicine does so much depend on what the physician does or does not do. A skilful and experienced operator will save nearly all the mothers and a large number of children.

In general, statistics show a mortality of 6 to 25 per cent. for the mothers and 50 to 75 per cent. for the children. Undoubtedly the percentage of recoveries is larger now than twenty years ago, and there is also no doubt that this is due to a better application of the methods of asepsis and to a more general introduction of Braxton Hicks' version into the treatment.

The dangers in placenta prævia for the mother are hemorrhage, sepsis, air embolism and rupture of the uterus. Sepsis is common because of the low position of the placental site, near the infected

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<sup>4</sup> American Journal of Obstetrics, vol. lxiv, No. 4.

vagina, and in the field of all the operative manipulations. These often have to be executed hurriedly, and the rules of asepsis are thus often violated. Air embolism is not an infrequent cause of death and one that can hardly be foreseen or prevented. I am aware that experiments on animals have shown that large quantities of air may be injected into the veins without causing death. The published cases of air embolism leave little doubt of the presence of such danger in the human subject.

Rupture of the uterus is nearly always an error of the accoucheur. It is due to too hasty or too forcible extraction of the fetus. It is usually the result of an attempt to save the infant's life by rapid delivery, but experience shows that the attempt oftener fails to save the child and not seldom results in a ruptured uterus, fatal to the mother. In rare cases of low implantation of the placenta the uterus may rupture spontaneously, or under even gentle manipulations. This is due to the changes wrought in the uterine wall by the placenta. The uncertainty of the uterine musculature, therefore, should all the more warn to carefulness in version and in extraction.

For the child the dangers are asphyxia from loosening or compression of the placenta, from compression or prolapse of the cord, from anemia of the mother, second hemorrhage from tearing of the placenta, and third, prematurity.

#### TREATMENT

Many factors enter into the selection of a course of treatment for the individual case of placenta prævia. One has, in addition, several methods to choose from. These factors are:

- (1) The environment of the patient.
- (2) The necessity of preserving the child.
- (3) The general condition of the child, *i. e.*, its chances for life.
- (4) The condition of the mother.
- (5) The skill of the accoucheur.
- (6) The degree of the prævia, that is, how much of the os is covered by placenta.
- (7) The amount of dilatation of the cervix.
- (8) Whether the patient is in labor or not.

I have treated 47 cases of placenta prævia with two deaths, and

have had the privilege of seeing several treated by others. From this experience I have acquired certain notions regarding treatment and feel justified in making certain statements regarding the formidable accident. In these deliberations the published experiences of other accoucheurs and the practice taught in standard text-books at home and abroad have all obtained full share of study.

(1) A woman with placenta prævia should not die except in very rare instances, such as air embolism, hemorrhagic diathesis, spontaneous rupture of the uterus.

(2) With a few exceptions every case of placenta prævia requires immediate interference. As soon as the diagnosis is made labor is to be inaugurated. The exceptions are in case the child is not yet viable, and in case hemorrhage is very insignificant. In these cases an attempt may be made to prolong the pregnancy in the interests of the infant, *but* the woman must remain in bed in a good maternity, where she can have the instant attention of a capable obstetrician. A flooding may occur at night and she may die before help can reach her. Even in a hospital she is running some risk in waiting. Dr. W. W. Jaggard used to insist that "there is no expectant plan of treatment for placenta prævia." I agree with this, but make an occasional exception. When, however, the child is well developed, there is no further occasion for expectancy, and under the favorable conditions of the maternity labor should be inaugurated. If the patient refuses this course of treatment it is wisest to drop the case.

(3) All cases of placenta prævia should be sent to a well-equipped maternity, unless the patient has means to provide several physicians and nurses in her own home. Otherwise it is impossible to give the parturient all the benefits of our art, and a makeshift method of treatment has to be substituted.

(4) The inexperienced practitioner should follow Schroeder,<sup>5</sup> who says "that accoucheur will have the best results in placenta prævia who has the least regard for the child."

Medical writers whose words are read by the general profession, and medical teachers whose precepts are followed by, at first, blind and inexperienced hands, should be careful what they recommend for universal practice. One should recommend to those of

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<sup>5</sup> *Lehrbuch der Geburtshilfe*, 12th Ed., p. 759.

less skill only such measures as in such hands will lead to the best results. The man with his first case of placenta prævia, therefore, should direct his efforts to save the mother. Later on, when he has acquired manual dexterity, when the eyes have developed on his finger tips, and when, rarest and most difficult attainment of all, obstetric judgment has become a possession of the accoucheur, he should make an earnest effort to improve the mortality of the child.

(5) When the labor has begun in a case of placenta prævia the accoucheur must stay with the patient until she is delivered and out of danger.

(6) No one method of treatment is applicable to all cases. The accoucheur should know all methods and individualize strongly. In addition, the accoucheur must be acquainted with and be able to execute all the maneuvers the surgeon possesses to secure hemostasis, as suture of the cervix, laparotomy, hysterectomy, etc.

(7) The best method of inducing labor is, puncture of the membranes, the introduction of a colpeurynter on top of the placenta and traction on the tube.

(8) At all times in the treatment of these cases the accoucheur should heed this warning. Save blood! One never can foretell how much blood the woman will lose in the successive manipulations required. If one is extravagant with her supply during the first and second stages, the normal loss of blood in the third stage may prove the fatal drain. The woman's reserve stock of blood must be most carefully guarded. Therefore, if, on the arrival of the accoucheur, he finds the patient already anemic he must at once institute radical and definitive treatment.

DURING PREGNANCY, before labor pains have begun, if one has decided to assume the risk and to temporize, the woman should be put to bed at the first indication of hemorrhage, and she should be in a perfectly appointed maternity. If the hemorrhage is free a firm vaginal tampon is to be applied. In all cases of hemorrhage during pregnancy a firm tampon is indicated in order to limit the loss of blood to a minimum. If the woman is to be transported to the hospital a provisional tampon is to be applied, as the unavoidable jolting on the way will increase or incite bleeding. The application of a tampon to control hemorrhage is by no means a simple matter. Unless the head is engaged in the pelvis it is impossible

to apply the tampon so firmly that all bleeding is checked, and since the head rarely has sunk so low, one must be content with checking the flow. Dry sterile cotton is best for the purpose and the rules of asepsis must be especially strict. Since, in all cases, the danger of infection is enhanced by the low position of the placental site, it behooves us not to increase this danger. Even an aseptic tampon, aseptically applied, becomes a source of danger very soon, and for this reason it should be removed in 12 hours and not renewed unless absolutely necessary. If the hemorrhage is soon repeated there is no wisdom in waiting longer. It is a wanton exposure of the mother to immediate and future danger for the sake of an infant which will probably succumb during delivery or shortly after.

If the patient is near the ninth month the child is viable and well developed, wherefore there is no reason in waiting.

DURING LABOR we have four objects to accomplish: First and most urgent, to stop the hemorrhage; second, to empty the uterus; third, to ensure hemostasis; fourth, to combat the anemia.

We must stop the hemorrhage, then, first of all, and it matters a great deal whether the patient has already lost much or little blood, when it comes to the selection of the method of stopping the flow.

In cases of marginal placenta prævia the hemorrhage usually begins toward the end of the second stage of labor and is very slight. In these cases one may try to wait for dilatation. One may not go away and wait! One must stay right at the bedside and watch the flow of blood and the progress of dilatation. If the hemorrhage should keep up, even if only moderate, puncture the bag of waters. This method is named after Puzos, who first introduced it (1759), but Puzos knew nothing of the nature of the placenta prævia. He considered detachment of the placenta the cause of all the hemorrhages during pregnancy.

The puncture of the membrane allows the placenta to retract with the receding lower uterine segment, to become, as it were, part of the uterine wall, thus arresting the process of separation, and the head may now enter the lower uterine segment and apply itself against the placenta, thus aiding in stopping the hemorrhage. But rarely a case will occur in which, even in marginal prævia, puncture of the bag of waters will fail to arrest the flow. Such cases are treated like central and lateral implantation.

The usual condition met is a more or less severe hemorrhage, with the os admitting two or more fingers. Pains may or may not be present, but some uterine action must have taken place or the hemorrhage and dilatation could not have occurred.

In such cases the membranes should be ruptured at once, but before this, all the preparations for the subsequent treatment of the case should have been made. If it is going to take several hours for the proper preparation of the case, to limit the bleeding a provisional tampon may be inserted. Save blood! This must be uppermost in the treatment at all times.

There are now two methods of treatment, Braxton Hicks' version and the metreurynter. Which one should be selected depends on several conditions. If the woman has lost much blood, if the baby is dead or dying, or if it is very premature, so that its chances are very small, if one has had no experience with placenta prævia,—perform Braxton Hicks' version. Bring down one foot, make slight traction on it so that the infant's thigh compresses the placenta against the cervix, thus stopping the hemorrhage. *Then leave the case to nature.* Do not extract the child; do not put traction on the leg unless the hemorrhage recurs. If oozing recommences pull lightly on the leg. The object of this method is to use the child's body as a cervical tampon, to stop hemorrhage, and to stimulate pains, *until the cervix is ready for safe delivery.* Neglect of the above advice and rapid extraction have cost many mothers their lives, and the object sought, the saving of the child, has usually been frustrated by the attempt itself.

In performing Braxton Hicks' version these points are to be noted. Puncture the membranes at the side of the cervix as far from the edge of the placenta as possible (Fig. 10). Then, disregarding the bleeding, which now commences, and is sometimes furious, the hand is passed into the vagina, the two first fingers through the rent in the membranes alongside the head. The head is gently pushed to one side, while the outside hand presses first the breech, then the foot, down in the direction of the inside fingers. The fingers seek the foot, and as soon as this is grasped, it is led down into the vagina. It is then very gently drawn out (Fig. 11), the other hand outside pressing the head upward toward the fundus. The secret in the performance of Braxton Hicks' version is com-



plete relaxation of the abdomen and uterus, and dextrous aid by the outside hand in pressing the foot into the grasp of the inside fingers. An anesthetic may be necessary for a few moments, but as soon as the foot is grasped the mask should be removed because anemic patients do not do well with anesthetics.

If the placenta covers the entire os, it is not advisable to waste many seconds in seeking its edge. It is better to bore through the most accessible portion.

It happens occasionally that delay is caused in performing the version after the membranes have been punctured. Perhaps the patient is unruly or rigid, or maybe the bleeding becomes so great that one fears for the mother's life. In such cases the bleeding may be temporarily checked by grasping the placenta and uterine wall, as in Fig. 12. This will give the operator time to collect himself. Another way is to grasp the whole cervix with the inside hand, press it against the head, while the outside hand forces the whole uterus firmly down into the pelvis. We must fight for blood every inch of the way.

After the version the case is absolutely under control. The woman can bleed no more, and measures may be instituted to replace the blood she has lost. Salt solution is administered intravenously or hypodermically (not per rectum).

Unfortunately, this method sacrifices a large number of children, and to save this stigma, Maürer and Duehrssen, especially the latter, introduced the second method mentioned, metreurysis. This, in brief, is the use of a rubber balloon to take the place of the breech in tamponing the cervix and lower uterine segment. Maürer in 1887 described this maneuver, but it is due to the labors of Duehrssen that it has been generalized, though even now few accoucheurs are aware of its immense advantages. It is applicable at all stages of cervical dilatation before the os is sufficiently open to permit delivery. It may be used to induce labor, or it may be used when version has been tried and has failed. One may dilate the cervix sufficiently to proceed with immediate delivery, or one may dilate sufficiently for the performance of version, after which the case may be treated according to conditions as they arise. The colpeurynter (or metreurynter) marks nearly as great an advance in the treatment of placenta prævia as did the introduction of Braxton Hicks' version.

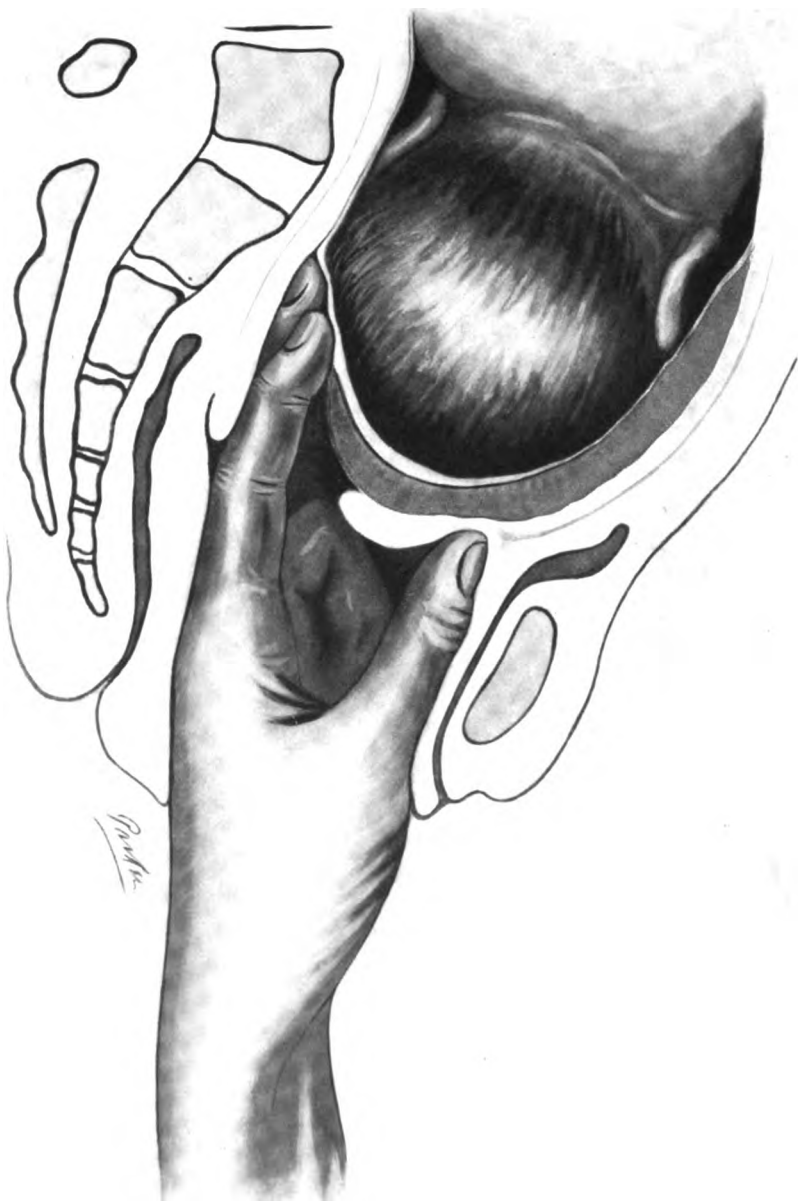


FIG. 10.—Puncturing the membranes at the edge of the placenta. If the finger cannot pierce the membranes a sharp-pointed scissors should be used. To check bleeding during the maneuver the thumb should press the placenta against the fetal head.

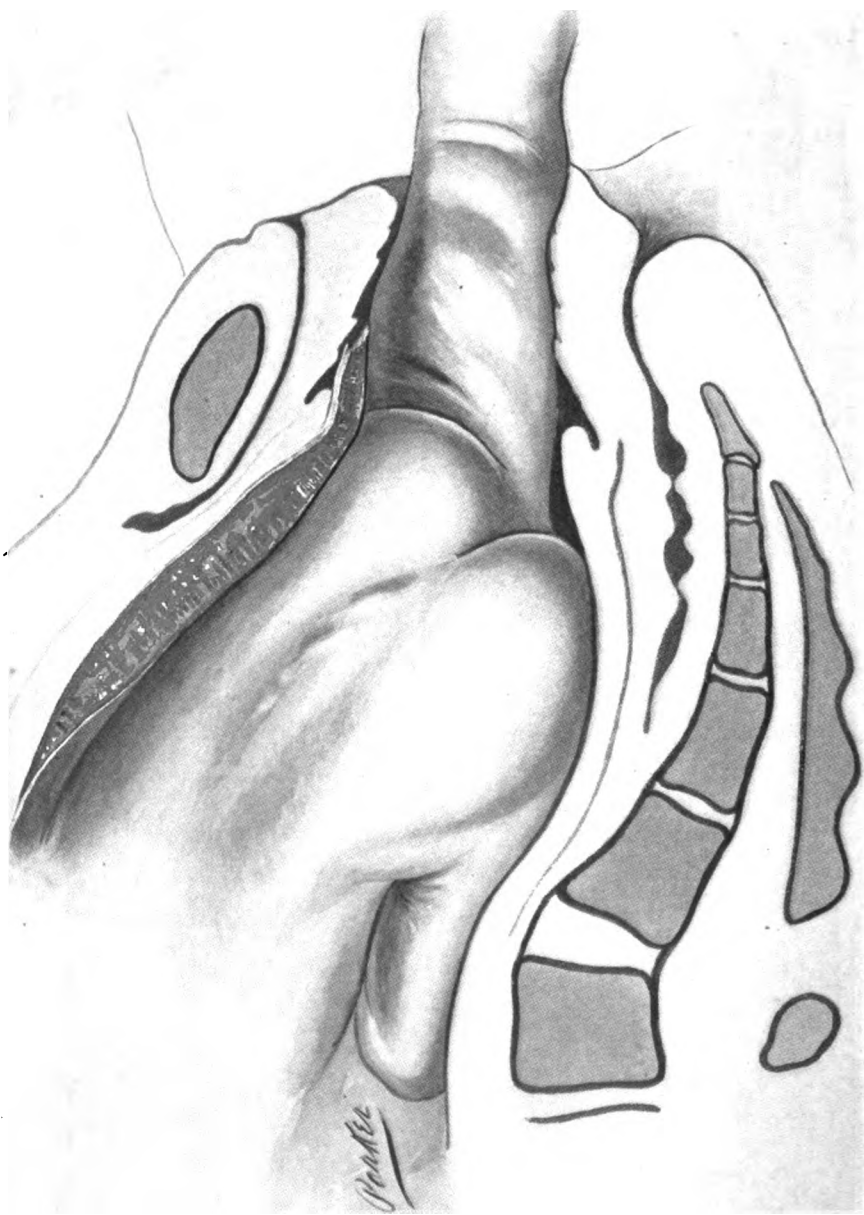


FIG. 11.—The Braxton Hicks version is completed. The breech of the infant now presses the placenta against the uterus, stopping further hemorrhage. A very slight amount of traction may be required to keep the breech snugly applied to the cervix.

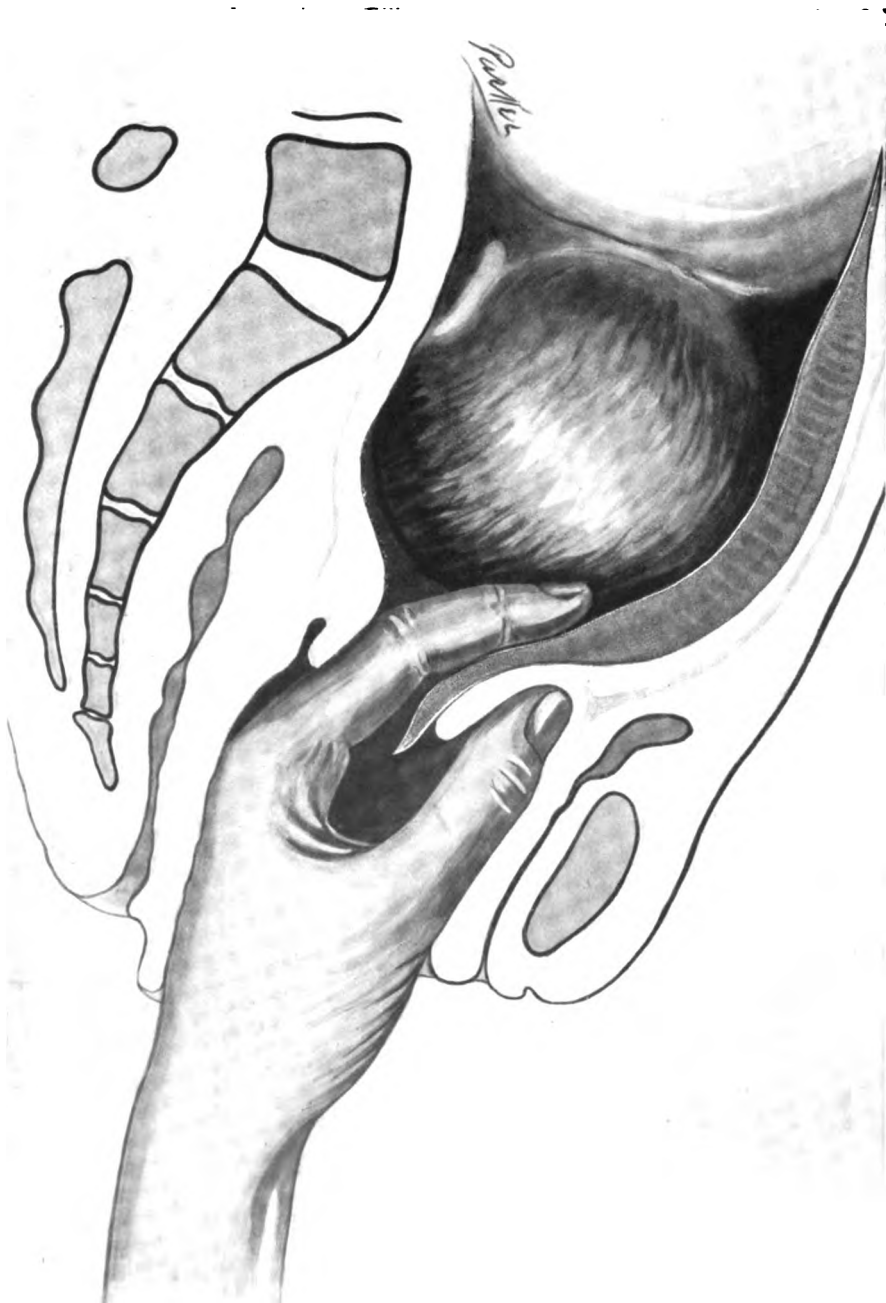


Fig. 12.—Holding the placenta against the cervix to control hemorrhage temporarily until other definitive measures may be instituted.

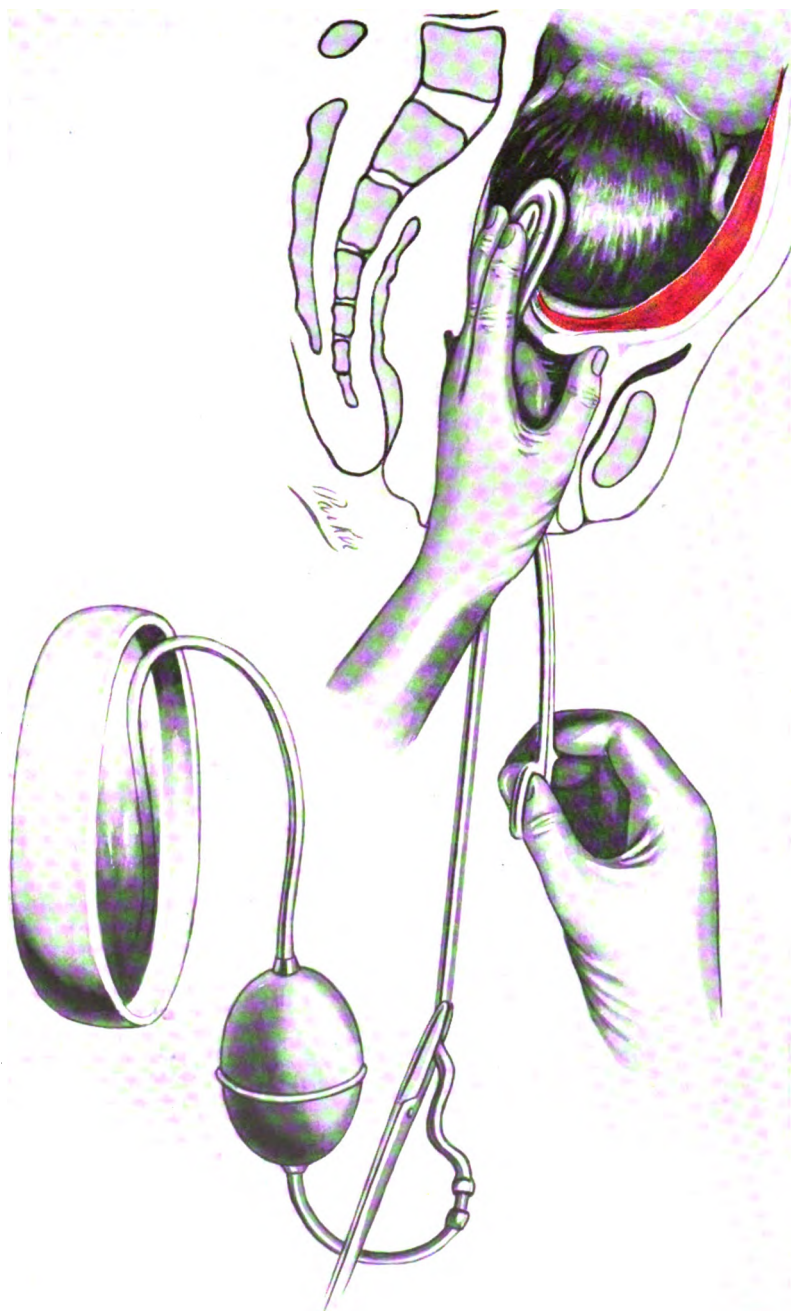


FIG. 13.—The Braun colpeurynter.



FIG. 14.—The long uterine packing forceps.

Fig. 15.—Passing the colpeurynter alongside the fetal head on top of the placenta.



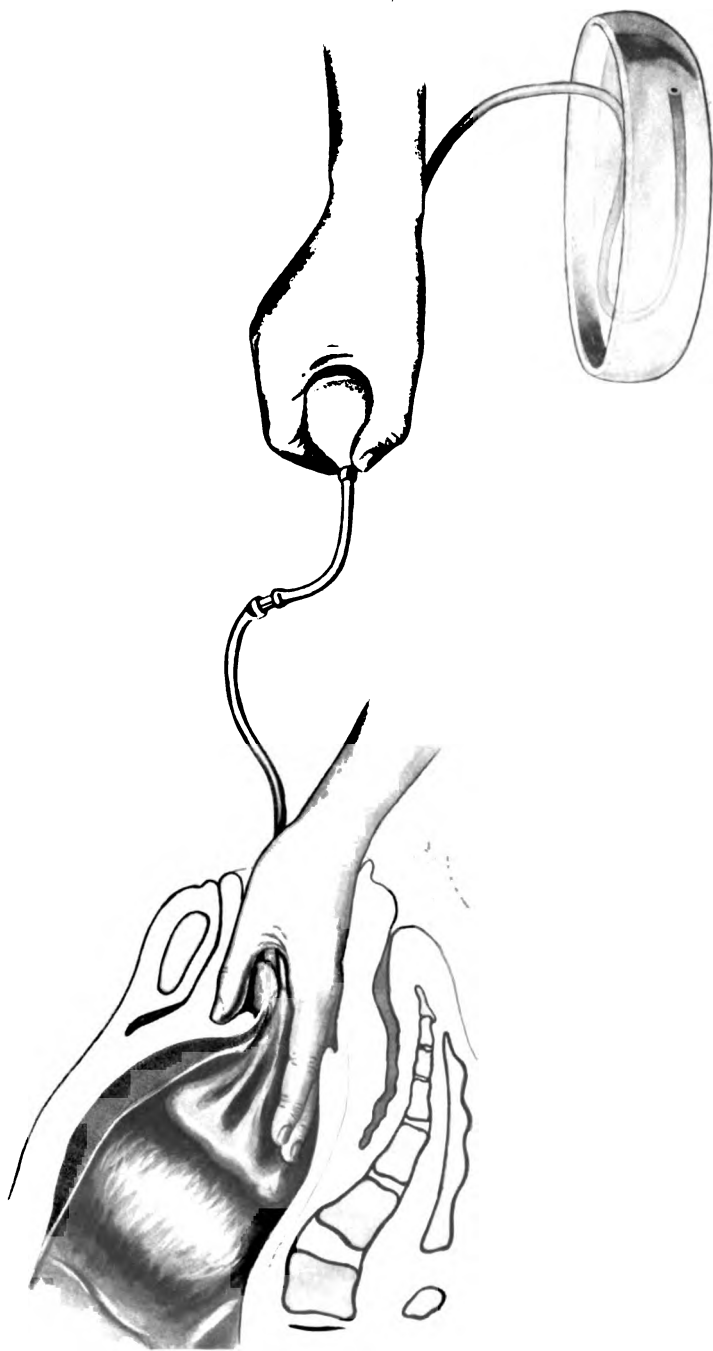


FIG. 16.—Filling the colpeurynter with the bulb syringe. The fingers steady the bag in position, and assure the operator that it does not curl up the edge of the placenta under its expanding portion.

Several bags are on the market. The original Carl Braun colpeurynter is as good as any of the later modifications, and I use it considerably (Fig. 13). Voorhees, of New York, made a modification of the Champetier de Ribes *inelastic* conical balloon, which is very serviceable, but is not large enough to secure complete dilatation. I use it in cases in which the head is low in the pelvis, as its flat top does not displace the head much, and when full dilatation is not required.

All preparations are made beforehand. The bag and the syringe for filling are sterilized by boiling 20 minutes in plain water. The colpeurynter is emptied of air first. This is accomplished by filling it with 0.5 per cent. lysol solution, then inverting it so that all this fluid runs out. A clamp is now affixed four inches from the end of the tube. The air is all pumped out of the bulb syringe and the nozzle fitted into the end of the tube of the colpeurynter. For greater security this tube may be tied on with tape. The bag is now folded lengthwise into as narrow a compass as possible and then grasped by the long uterine packing forceps (Fig. 14). The whole apparatus now lies in a basin of 0.5 per cent. lysol solution from which it is to be filled.

The membranes are now punctured as for the performance of version, and, operating quickly, guided by the two fingers in the cervix, the bag (Fig. 15) is placed inside the uterus *on top of the placenta*. Be careful not to push up the edge of the placenta so that it doubles under the colpeurynter. The clamp is now removed from the tube, and, steadying the colpeurynter on the placenta, the other hand by slow pressures on the bulb of the syringe injects the required amount of lysol solution (Fig. 16). Fourteen to twenty ounces are required, varying in individual cases. Each full compression of the bulb of the syringe is about one ounce, and in this way the amount may be estimated. If the child is small the bag is not fully distended; if the patient is at term, 18 or 20 ounces are needed. If too much solution is injected the bag will not apply itself to the placenta, and hemorrhage will continue, wherefore one will allow a few ounces of solution to escape. If too little is injected the colpeurynter will fall out before the os is sufficiently dilated. One must inject slowly in order not to overdistend and too rapidly stretch the lower uterine segment. The head, of course, is dis-



placed by the colpeurynter, but this cannot be avoided. Since, when the bag is expelled, delivery is consummated, little harm results from displacing the head. After the bag is in position one reassures himself that the placenta is underneath it and withdraws the hand from the vagina. Now the tube is clamped with an artery forceps and slight traction exerted on it. Only sufficient pressure is brought to bear on the placenta and cervix, as will stop the hemorrhage. This accomplished, the accoucheur seats himself at the bedside and maintains slight traction on the tube of the colpeurynter. One, at most two pounds will be enough, and to determine this one may insert a scale in the line of traction or fasten by means of a tape a bottle containing the proper amount of water hanging over the footboard of the bed.

I prefer to hook the ordinary baby scale into the artery forceps or pull on it myself, as in Fig. 17, and thus personally watch the traction. Every three or four minutes one should relax the pull, to allow blood to get into the cervix. An anemic cervix will tear more readily than one properly nourished.

Pains usually come on within an hour, and, while they are irregular, they accomplish the effacement and dilatation of the cervix. After an hour or so the pains become more regular. One relaxes the pull on the bag during the pain, resuming it when the contraction is over. One must avoid too powerful traction on the bag. This may rupture the cervix and lower uterine segment directly, or it may excite such powerful uterine action that this ruptures the uterus. I have had one such accident. Indeed, the pains must not be allowed to become too strong in placenta prævia. If such a danger threatens, stop pulling on the bag, and if this does not produce the desired effect, allow several ounces of fluid to escape from the bag.

The heart tones of the child must be carefully noted during the time the colpeurynter is in place. If the cord is in the area of the placenta compressed by the colpeurynter some asphyxia of the infant is unavoidable. This may not be fatal, but is very unwelcome, the more so because we are practically powerless to extract the child until the cervix is dilated. (I shall discuss Cesarean section later.) The most we can do is to try, if safe, to hasten the dilatation of the cervix somewhat. This is done by exerting a

little more traction on the bag, say two and one-half pounds—with, of course, the precautions already emphasized. If an urgent indication on the part of the child for delivery should arise before the cervix is sufficiently dilated it will have to be disregarded. The danger is too great for the mother. An indication for delivery will not arise on the part of the mother because we can control the hemorrhage by the colpeurynter or the breech. Great hemorrhage and collapse do not indicate rapid delivery; on the contrary, the sudden emptying of the uterus may add to the shock and turn the delicate balance against the woman. In such cases of severe hemorrhage and shock, the quickest and most definitive means of stopping the hemorrhage is by version and tamponing the lower uterine segment by the breech. One then has the case absolutely under control, and now the patient may be stimulated and her blood loss replaced with saline solution.

The obstetrician must possess a large fund of patience, as he may be required to hold on to the colpeurynter from three to twelve hours. Since there is no hemorrhage, and if the child is not in a serious condition, there is not the shadow of a reason for hurry, and especially since these hours may be employed in supplying the woman with fluids, as saline solution hypodermically, food, etc. The woman recovers from the shock of her first hemorrhage. The hours are also useful for the preparations for the delivery. No detail should be omitted and everything must be gotten ready and rehearsed beforehand, so that when the delivery is to be made not an instant's delay need be tolerated. A complete set of obstetric instruments should be sterilized, especial provision being made for the treatment of post-partum hemorrhage. Needles, long needle holder, vulsella, specula, etc., for sewing lacerations of the cervix may be needed, as well as gauze and long uterine packing forceps for tamponing the uterus. A table on which to place the patient for delivery should be ready, and provisions made for the resuscitation of the child, *e. g.*, tracheal catheter, hot bath, hot towels, etc.

The nurse prepares the douche bag for giving a hot (120° F.) injection of sterile water and sees that there is a supply of sterile solutions, sponges, towels, etc.

The next point of importance in the treatment is to determine the exact moment when the colpeurynter passes through the cervix.

If one neglects to note this, pulling on the tube brings the bag down onto the perineum and a large quantity of blood accumulates between it and the child (Fig. 18). If is a very serious loss, because one cannot control the hemorrhage so well after dilatation of the cervix as before, unless it is possible to deliver at once. Sometimes the head follows down and takes the place of the colpeurynter, tamponing the cervix securely. These are fortunate cases, and one has nothing to do but watch and let nature take the lead. It is advisable as soon as the head has passed the cervix to deliver, because the child's life is in a rather precarious position, and, second, the placenta may separate and blood may accumulate in the uterine cavity.

The accoucheur determines that the colpeurynter is passing the cervix, first by noting the steady advancement of the tube; second, by occasional direct internal examination one feels the cervix slipping over the greatest circumference of the bag; third, the patient begins to bear down, and the pain has a sharp, cutting character; fourth, after the bag has passed through the pains cease or are milder; fifth, the bag is expelled,—but the two latter signs show delinquency on the part of the accoucheur. As the bag is passing through the cervix the attendant must be ready to deliver, or to do a version, as indicated. The time consumed in getting ready after the bag has slipped through the os may mean a fatal loss of blood.

If the head does not follow the metreurynter into the pelvis, the operator withdraws the bag quickly from the vagina, emptying it if necessary, as quickly inserts his whole hand and grasps the cervix and placenta, till he can determine on the course of procedure. If the head is still high, he tries to force it down into the pelvis. This will stop the hemorrhage and allow forceps to be applied. If the head does not go into the pelvis podalic version is to be performed. As a rule the cervix is sufficiently prepared to permit immediate extraction, but let me again sound the warning,—beware of too hasty extraction through an ill dilated cervix! The laceration of the highly vascularized cervix is one of the most formidable accidents the accoucheur could meet. The utero-placental sinuses are so superficial that a tear one-eighth of an inch deep may lay one open. The contraction and retraction of the

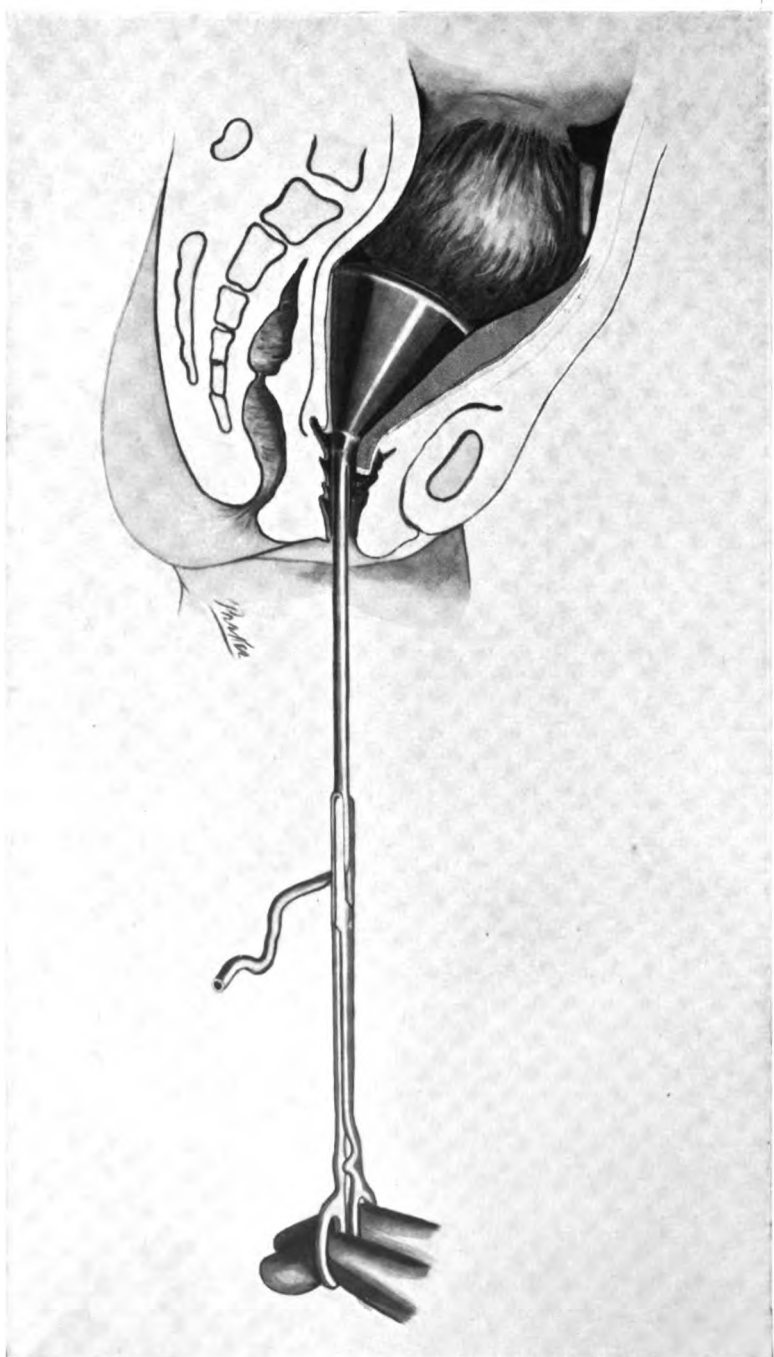


FIG. 17.—Making traction on the bag after it has been filled. A scale may be inserted between the fingers and the forceps to show the number of ounces of traction.

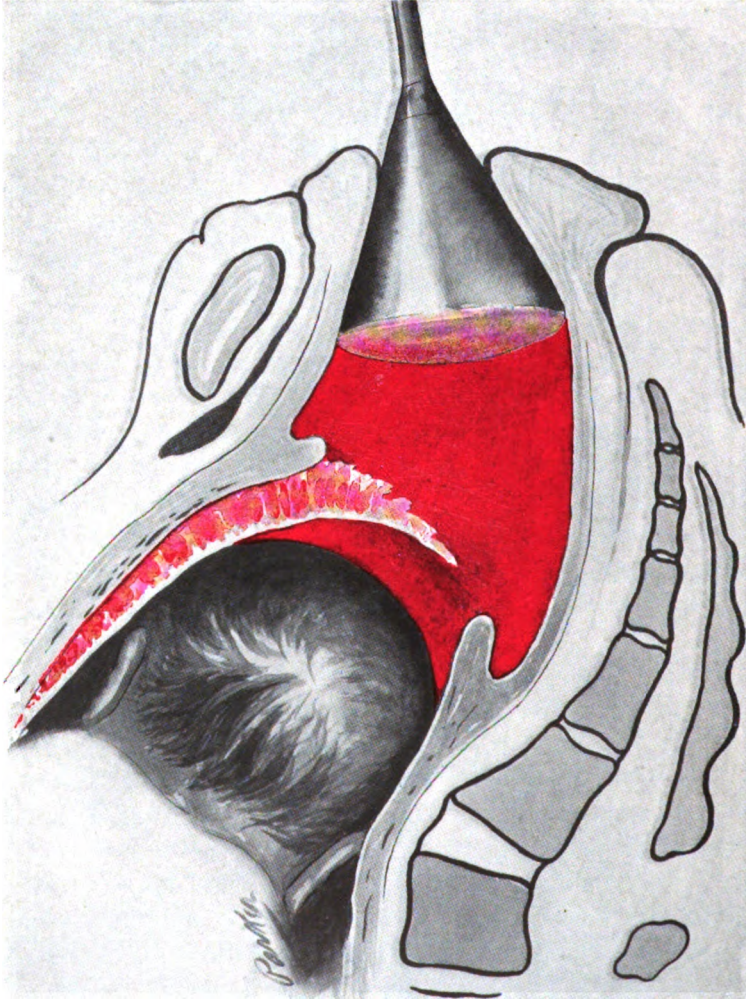
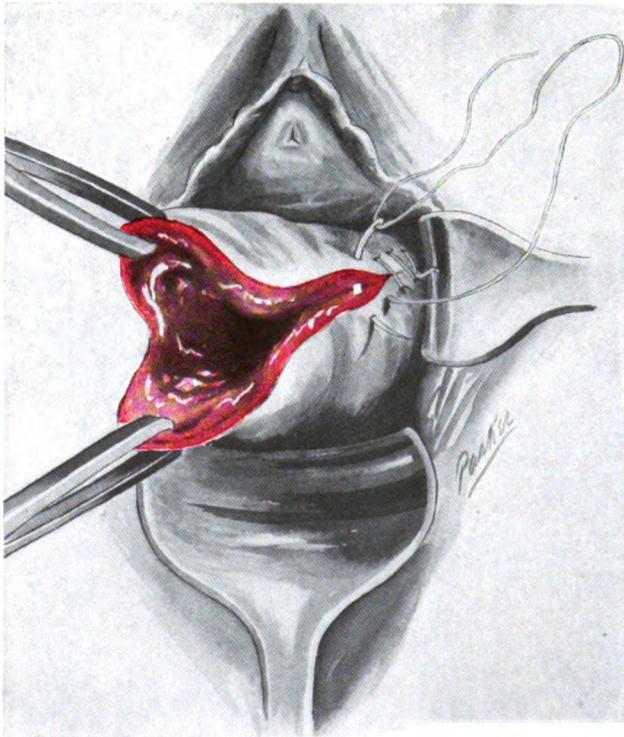
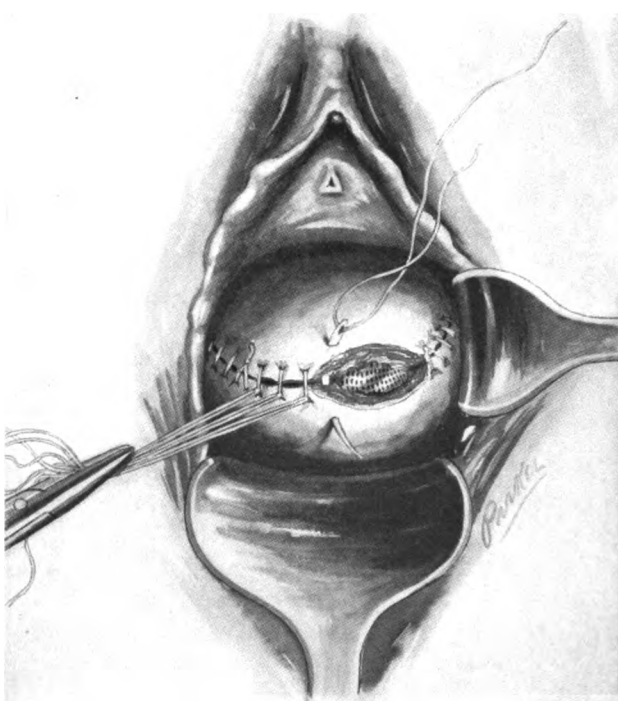


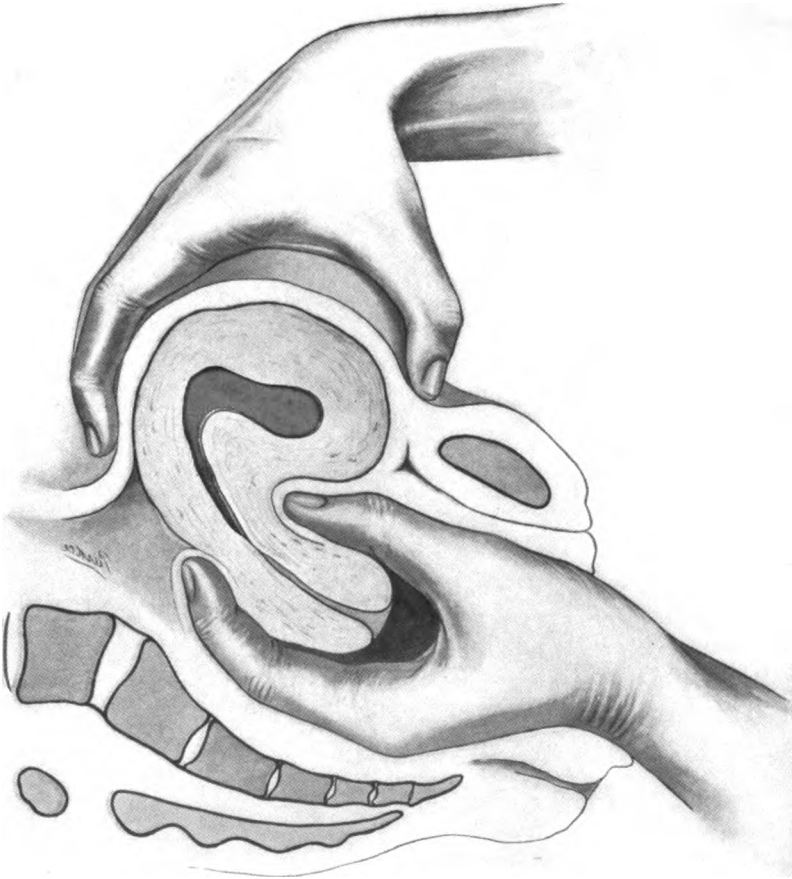
FIG. 18.—The colpeurynter has escaped from the cervix and rests at the vulvar outlet, permitting a large amount of blood to collect behind it. This is an error in technic.



**FIG. 19.—Sewing up a lacerated cervix. The two lips are drawn down with vulsellum forceps. A short curved needle is used. Since haste is imperative a continuous suture is applied.**



**FIG. 20.**—The sides of the cervix are sewed with a continuous suture of catgut. The uterus has been packed. The lips of the cervix are now closed over the packing with interrupted sutures of silk worm gut.



**FIG. 21.—Compressing the uterus in anteversion to stop hemorrhage. The left hand inside grasps the whole cervix, while the right hand outside compresses the fundus and forces it down on the left hand.**





lower uterine segment are poor at best and poorest in placenta prævia, and this means of hemostasis is not strong, so that the cases of fatal hemorrhage from even tiny tears of the placental site are easily explained. If the cervix is not sufficiently dilated by the first attempt with the colpeurynter, one may reinsert it and fill it with a still larger amount of water, 20 to 22 ounces, which will dilate the os to nearly the size of the fetal head.

Should placenta prævia occur in a primipara, or in others, and the cervix be closed so that one finger may not be introduced, the case becomes more formidable still. For these cases the vaginal tampon and the colpeurynter have been recommended. There are real objections to both on the score of sepsis and inefficiency. Unless the head is firmly engaged in the pelvis the tampon will not exert sufficient compression of the cervix and placenta against the head, so that the bleeding is checked in this manner. Then the external is converted into an internal hemorrhage. The same is true of the colpeurynter. I have never failed to pass the colpeurynter into the uterus, and I never use the tampon unless provisionally, during the transportation of the patient or while other preparations are being completed. It is for these cases that Cesarean section has been recommended.

**TREATMENT DURING THE THIRD STAGE.** Many patients have been lost during the third stage, after having been skilfully carried through the other two stages. The same economy of blood is here practiced. Save blood at all times.

In placenta prævia a tiny laceration may give rise to a fatal bleeding. The soft, vascularized cervix is difficult to seize for suturing, and it may be impossible to sew up a laceration or to sew it up quickly enough to save an already exsanguinated woman. Therefore, be well prepared for the complications of the third stage. In suturing a laceration of the cervix it is necessary to expose the field thoroughly by broad retractors. (Fig. 19.) The lips are grasped with vulsellum forceps and the tear brought within reach of the needle. Usually the field is so flooded with blood that it is impossible to see where to sew. In one such case I packed the uterus and the rent in the broad ligament firmly with gauze, thus stopping the furious flow, after which the lips of the cervix were united over the tampon, thus closing up the uterus entirely. (Fig.

20.) Then the vagina was snugly packed with dry cotton, to exert counter-pressure. The sutures were removed the next day and the gauze two days later. The patient recovered.

The placenta in these cases, exposed during pregnancy to infection from the vagina and from endometritis, is often pathologically adherent. Contraction and retraction of the lower uterine segment are poor, wherefore the separation and expulsion of the placenta are slow. Hemorrhage from local atony therefore adds another complication, with or without placental adherence. Manual removal of the afterbirth and membranes is not seldom necessary. Increased alertness at this period is thus demanded.

As soon as the child is delivered, as in Cesarean section, it should be handed to a competent assistant, the operator giving his individual attention to the mother. Even a moderate hemorrhage now demands the immediate removal of the placenta. Then follows brisk uterine massage, with a hot (120° F.) uterine douche. If the bleeding does not instantly cease definitely, tampon the whole utero-vaginal tract firmly with gauze. While waiting for the gauze, during the 10 to 20 seconds necessary, it is wise to hold the uterus firmly in ante-flexion, as in Fig. 21.

*Waste no precious seconds on uncertain methods of hemostasis, but in the presence of such urgent indications use the most radical and definitive means we have.*

The gauze that I use for tamponing the uterus is 13 yards long and one-half yard wide. The selvedge and raw edges are folded inside, the gauze is washed in running water, boiled in 0.5 per cent. lysol solution, then packed into sterile jars and twice sterilized in flowing steam for two hours on successive days. The edges of the cover are sealed with paraffin, the jars wrapped in paper and kept dust free. Thus prepared, gauze will remain aseptic for years. It is applied directly from the jar, by means of long blunt curved forceps (Fig. 14) made for the purpose.

Before, during, and after delivery in cases of placenta prævia, it is often necessary to treat the anemia. If the mother has lost much blood give her saline solution under the skin, not per rectum, as this interferes with the asepsis of the local treatment. When the bowels are moving over the field of operation it is difficult to avoid carrying the discharges into the uterus. Saline solution is

to be given even if the hemorrhage is going on, as then the patient does not lose pure blood, but blood mixed with salt solution. We do not wait for fainting to stop the hemorrhage in placenta prævia.

No reference has been made to other methods of treatment of placenta prævia, the reason being that they are inefficient and obsolete. Accouchement forcé, rapid, forced delivery, is in my opinion an almost criminal procedure in placenta prævia. The reasons have been sufficiently stated above. The results condemn it. Bossi's steel, branched, powerful dilator also has no place in the treatment. We want gentle dilators. Even the soft rubber bag may be dangerous unless handled properly.

In the last few years a new way of overcoming the difficulties and dangers of this complication has been introduced and is very slowly gaining reluctant recognition. Cesarean section has been performed in cases of central and lateral placenta prævia by surgeons and gynecologists, because, to them, this was the quickest and easiest way to carry out the treatment. The obstetricians as a rule have condemned the procedure, and among others Ehrenfest, of St. Louis, and Holmes, of Chicago, have sought to prove that the operation does not give as good results as the usual methods, properly performed. Schauta<sup>6</sup> says that the operation is not to be performed. Nevertheless I believe that Cesarean section has a place in the treatment of these cases, and that the indication for the abdominal delivery will be broadened as the years go on, and as abdominal section becomes more and more safe. Cesarean section in the best hands has a mortality of 4 to 7 per cent. for all cases operated on.

If one could select the cases, the mortality might be reduced to 3 per cent. The treatment of placenta prævia will have difficulty to show a lower mortality than this. Hofmeier gives it at 6 per cent. I have had 47 cases with 2 deaths, 4.25 per cent. One death was from sepsis (midwives treated the case for six weeks, *stilletidum sanguinis*), the other from rupture of the uterus.

The present mortality of Cesarean section for placenta prævia is hard to figure, but it probably is over 25 per cent., so that the percentages would be against the abdominal operation if it were not

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<sup>6</sup> *Lehrbuch der Gesamten Gynäkologie.*

for the child. When one considers what small provocation the gynecologist needs to open the belly,—a pain in the back, sterility, a harmless fibroid for example, one might marvel a little at the reluctance of the accoucheur to do the same to save a child's life.

Then, too, the treatment of a case of placenta prævia by the usual methods is not simple or easy. Those of experience and those who have read the preceding pages will concur with me that great skill is required, great sacrifice of time demanded, and great anxiety entailed by a case of this sort.

Small wonder then that the surgeon grasps the knife as the quickest and easiest way out of the difficulty.

Without going into the discussion further, I would state that an indication for Cesarean section would arise in cases of central placenta prævia, with a long, hard, closed cervix, and living child, near term, the mother being in good condition, aseptic facilities and a man capable of his task being obtainable. If these conditions occur in a primipara the indication is stronger. The rule in placenta prævia should be, if the mother is in good condition one is bound to make an effort to save the child, if the mother or child is in poor condition one is bound to save the mother.

Under this rule and as cases of placenta prævia occur the indication for Cesarean section will be a rare one, but, in my opinion, the accoucheur is remiss in his duty if he does not individualize his cases carefully and select from them those in which an attempt may be made to save the child's life by radical measures.

Vaginal Cesarean section has been done by Duehrssen at the sixth month for placenta prævia. I gave a description of this operation in the April, 1906, volume of the INTERNATIONAL CLINICS, in an article on Eclampsia. Theoretically this operation would be contraindicated by the great vascularity of the parts. Clinically there have been only a few cases reported, so that judgment must be withheld.

## LACERATIONS OF THE CERVIX OF THE UTERUS AND THEIR REPAIR

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IN an exceedingly able and comprehensive article<sup>1</sup> George H. Simmons remarks, while speaking of laceration of the cervix: "We cannot help but wonder how this condition remained unrecognized as long as it did. For twenty-five years after the invention of the speculum the condition which we now know to be simply a tear was looked upon as an ulceration without any traumatic cause." Grailly Hewitt, of London, writing in 1882, says: "Is it not a little remarkable that, largely used as the speculum has been in the investigation and treatment of the diseases of the uterus, cases of severe laceration of the cervix seem to have been overlooked until a very recent period, even by those who were most in the habit of employing the instrument." Simmons adds: "It was left to Dr. Thomas Addis Emmet to first describe the true character of this lesion and to give us a radical measure of cure. His first paper on the subject, published in 1869, brought it before the profession, and while it was slow in being adopted, still twenty years ago it was generally accepted by the leading gynecologists of America, although it was many years before it was hardly discussed in Europe. And it is astonishing with what pertinacity some of the leading gynecologists of Europe are still opposing this operation. Tait, in his last work on diseases of women, says: 'A great flood of operations has gone through the practice of gynecology of recent years for the stitching up of this innocent fissure. The real trouble is the subinvolution and the consequent chronic metritis, and nothing more useless than Emmet's operation has ever been introduced into surgical practice.'" Again, Simmons says: "In looking

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<sup>1</sup> Jour. Amer. Med. Assoc., October 20, 1894.

through the London *Lancet* for the last ten years the subject is mentioned scarcely half a dozen times. The only elaborate article is a long editorial review<sup>2</sup> of an exhaustive thesis by Noeggerath, of Wiesbaden.<sup>3</sup> Noeggerath sums up his investigation with the following six conclusions, which are heartily indorsed by the reviewer: '(1) Women with laceration are more prone to conceive than those without; they are also less likely to miscarry. (2) The position of the uterus is not affected by laceration. (3) The axis of the uterus is not elongated by laceration. (4) Ulceration and erosion are as common in one class as the other, and diseases of the cervical tissue are not more common in lacerated than unlacerated cervixes. (5) Lacerations have no influence in producing uterine disease either as regards frequency or intensity. (6) Eversion of the lips is never the result of a laceration. The restoration of the shape of the cervix can have no influence on the uterus.'"

Such were the statements of a distinguished gynecologist not a score of years ago. Stated exactly opposite to what they are, and they will be accepted to-day as axioms by every gynecologist of any standing whatever. Was there ever a more striking reversal of opinion in as short a period of time?

Laceration of the cervix is an accident which is very commonly followed by serious morbid changes in and about the pelvic structure. It is an exceedingly common accident of parturition. In a sense, more or less of a tear takes place in all first labors, and in this sense the tear, which is nothing more than a conversion of the cylindrical cervical canal with a circular opening into a fissured canal with a transverse slit or orifice, is not recognized as a tear at all. It is regarded, in reality, as one of the wise provisions of Nature for the facilitating of subsequent parturitions. When the process is carried beyond this mild degree it then becomes a true traumatism, and may be dignified by the terms "laceration" or "tear."

When it is recalled that the diameter of the cervical canal in the non-pregnant uterus is about one-fifth of an inch, and that this diameter must be increased by attenuation and softening of the cervical tissues with progressive dilatation to permit the passage

<sup>1</sup> *Lancet*, 1888, i, 231.

<sup>2</sup> *Berl. klin. Woch.*, 1887, No. 41.

of the fetal head having a diameter of about four and one-half inches, the only wonder is that every cervix does not become the seat of most extensive multiple lacerations. It has been estimated, however, that from 30 to 40 per cent. of all parous women suffer from true laceration of the cervix, more or less severe. Of these tears some will heal by primary union, but at least 16 to 20 per cent. will require surgical intervention for relief of the condition.

As a rule, the injury is not known to have occurred at the time of labor, unless it has extended deeply into the tissues—to and within the vaginal vault—when it occasions one form—and a perplexing variety—of post-partum hemorrhage. The bleeding in these cases takes place from the ruptured circular artery of the cervix or its branches, and may result fatally, notwithstanding that the gravid uterus has been thoroughly emptied and remains contracted. Marx<sup>4</sup> has recorded a case of fatal hemorrhage following cervical laceration. Bearing in mind the possibility of the super-vention of such a serious result, it is well to remember that, generally, simple traction upon the cervix by a vulsellum forceps in such a direction as to produce flexion of the collum upon the corpus uteri will temporarily check the bleeding and afford time for the introduction of a deep suture around the bleeding vessel.

**THE CAUSES OF CERVICAL LACERATION.** There are two causes only for cervical laceration, namely, parturition and traumatism, as that resulting from some operative procedure such as rapid progressive dilatation for the correction of cervical stenosis.

Jarman<sup>5</sup> has expressed his belief that lacerations of the neck are, in most instances, unavoidable, occurring as they do most frequently in cervices that are congenitally malformed. It is well recognized that cervices which, in the non-pregnant state, are long and conical, often do not permit of that degree of dilatation which is essential for the transit of the fetal head without the occurrence of a rupture. This congenital deformity, then, should be regarded as a strongly predisposing cause of laceration. Here may be included also any other congenital pathologic condition of the uterus which will interfere with free dilatation at the time of the confine-

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<sup>4</sup> Med. Rec., Nov. 12, 1898.

<sup>5</sup> Amer. Medico-Surgical Bull., March 28, 1896.



ment, such as undue rigidity from the presence in the cervix of an excess of connective tissue.

The exciting causes of the injury are precipitate labor without the necessary time for complete dilatation of the os; forcible delivery of the after-coming head in breech-presentation or after version, when the cervix has been insufficiently dilated, or when it has retracted around the neck after the shoulders have escaped; malposition of the fetus during the process of delivery; wedging of the anterior cervical lip between the os pubis and the fetal head; dry labor (lacerations occur much less frequently when rupture of the membrane does not take place until complete dilatation has been accomplished); inexperienced or improper use of the forceps; and accouchement forcé.

**CONGENITAL SPLITTING OF THE CERVIX.** It becomes necessary at this point to make reference to an interesting condition which is infrequently noted, but which presents all the characteristic clinical features of a true cervical laceration. This is the so-called congenital split or laceration of the cervix uteri with erosion or ectropium of the mucous membrane of the canal. Attention was first called to this condition in 1872 by Leopold<sup>6</sup> and later in 1880 by Fischel.<sup>7</sup> Since then C. B. Penrose,<sup>8</sup> Jefferson,<sup>9</sup> C. P. Noble<sup>10</sup> and others have reported cases of congenital lesions of the cervix, including a case occurring in the practice of Dr. T. A. Emmett in 1880.

According to Fischel, "in most cases the external os forms a rather narrow transverse opening surrounded by an erosion which extends on the lateral surfaces of the cervix higher up than on the anterior and posterior aspects. In other cases still, and these bore the nearest resemblance to erosions in the adult, the change was limited to the under surfaces of the lips of the cervix as far as they came in contact with the posterior vaginal wall." Fischel further calls attention to the fact that the dividing line between the epithelium of the vagina and that of the uterus does not lie always at the outer-

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<sup>6</sup> Transactions of the Gesellschaft f. Geburtsh., Leipzig, July 15, 1872.

<sup>7</sup> Archiv. f. Gynäk., Bd. xvi, s. 192, 1880.

<sup>8</sup> Am. Jour. Med. Sci., May, 1896.

<sup>9</sup> Med. Sentinel, Dec., 1896.

<sup>10</sup> Am. Gyn. and Obst. Jour., Feb., 1897.



**FIG. 1.**—Stellate, or multiple, laceration of the cervix uteri.

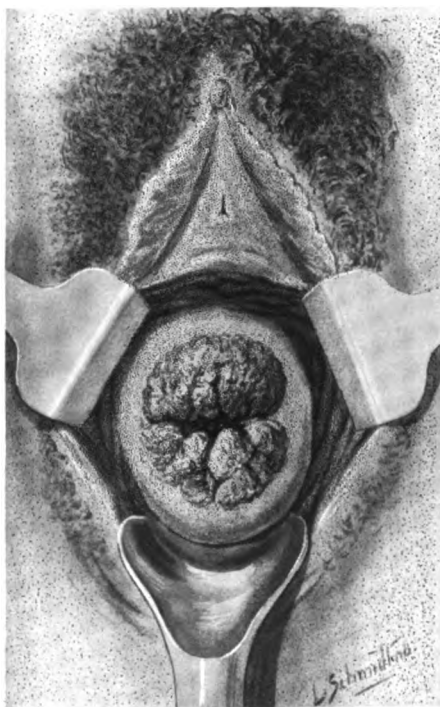
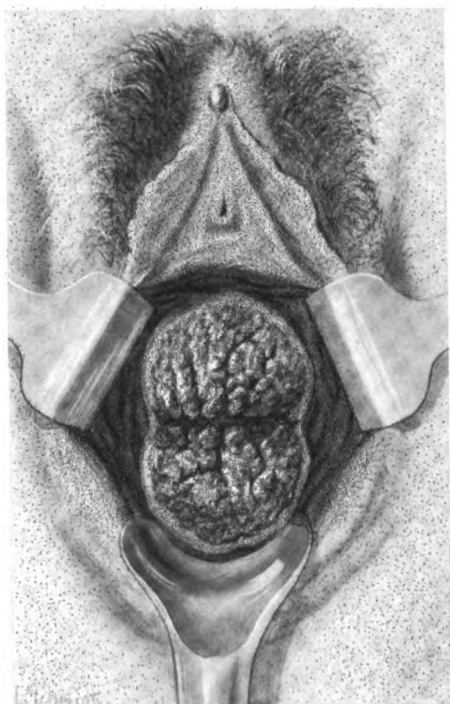


FIG. 2.—Bilateral cervical laceration, with erosion of both lips.



**FIG. 3.—Extreme bilateral cervical laceration, with eversion and erosion of both lips.**

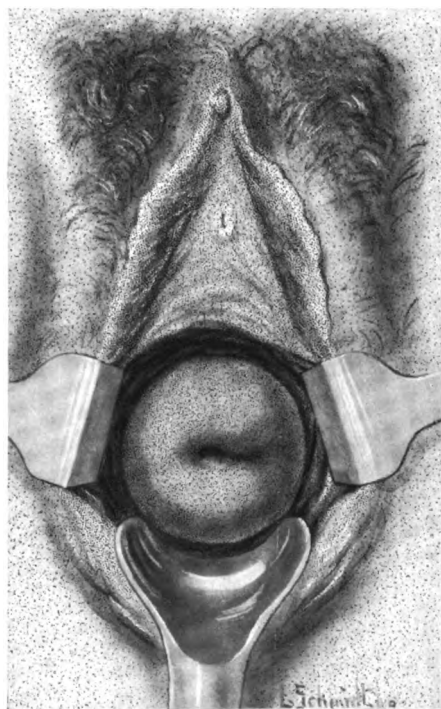


FIG. 4.—Unilateral laceration of the cervix uteri.

most end of the cervical canal, but may be situated even on the external vaginal surface of the cervix more or less high toward the vaginal fornices. He terms this condition "congenital histological ectropium."

When such a state persists until adult age the proper treatment consists in an amputation of the deformed cervix.

**VARIETIES OF CERVICAL LACERATION.** Laceration of the cervix may extend in any direction and to any distance upward, downward and outward. Consequently they may be classified as unilateral, bilateral, anteroposterior, incomplete, and stellate or multiple (Fig. 1). An exceedingly rare variety is the so-called annular or circular separation of the cervix, in which a complete ring of the cervical margin is torn away from the supravaginal cervix, usually by the action of forceps, though occasionally it may occur spontaneously. Cases of this variety of tear have been recorded recently by Julius Sachs<sup>11</sup> and Hugh Crouse.<sup>12</sup>

The most common tear is the bilateral, which may be mild in degree (Fig. 2) or severe (Fig. 3), the latter extending into the vaginal vault. The higher these tears extend the greater the loss of blood, and this variety may require immediate interference by tamponade or suturation. The latter is preferable in that it not only checks the hemorrhage, but produces obliteration of the wound, and permits the formation of a linear cicatrix. It is well to note, however, that suturation is contraindicated in cases in which the large connective tissue interspaces are opened up and there exists a tendency to hematogenous formation with imminent danger of subsequent infection of the clot.

The tear next in frequency of occurrence is the unilateral (Fig. 4), which is observed most commonly upon the left side. The reason for this sinistral preference is not fully determined. The general acceptance is that it is due to the greater frequency of left anterior vertex positions of the fetus, which, it is said, throw a greater strain upon the left side of the lower uterine segment. Jarman,<sup>13</sup> however, does not think that this explanation is "tenable from the fact that if

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<sup>11</sup> Phila. Med. Jour., Jan. 14, 1899.

<sup>12</sup> Med. News, Nov. 7, 1903.

<sup>13</sup> American Medico-Surg. Bull., March 28, 1896.

it is due to the direct action of the occiput we should find the lesion occurring in the right oblique diameter, where as in reality the tear nearly always occurs at a point somewhat posterior to the left lateral radius." He offers in substitution the following: "First, that lacerations of the cervix do not take place until after the occiput has rotated forward, in occiput anterior positions. Second, that the tear is produced when the anterior portion of the cervix is caught between the occiput and the pubes, and the posterior portion of the cervix retracts over the brow, face, and chin." This theory is plausible, to say the least, and from the clinical showings would seem to be more accurate than the commonly accepted view.

Anterior lacerations are commoner than is generally recognized: They usually heal spontaneously and thereby escape observation. They may, rarely, invade the bladder and vesico-uterine pouch, and result in the development of a vesico-utero-vaginal fistula, which may persist, or which may slowly heal spontaneously. In other cases a ureter has been torn through, with a resultant uretero-uterine fistula, as was noted in a case in the practice of Mann of Buffalo.

Posterior tears (Fig. 5) may be slight, in the lip only, or they may extend upward and invade Douglas's pouch. Such lacerations are a fruitful source of post-uterine infection, and of the subsequent development of cicatricial contraction with adherent retroflexion of the uterus.

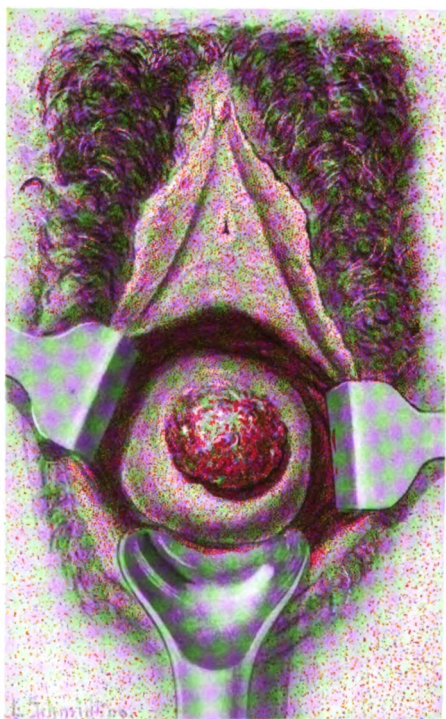
In incomplete cervical laceration (Fig. 6) the structures of the cervix are split unilaterally or bilaterally to, but not through, the mucosa of the vaginal aspect of the cervix. This intact outer mucous membrane prevents gaping of the external os. Not infrequently in this variety of laceration one or the other lip will undergo hypertrophy and hyperplasia and become the seat of an erosion.

**SYMPTOMATOLOGY OF CERVICAL LACERATIONS.** As has been already indicated there is a notable absence of clinical manifestations during the puerperium provided that the cervical laceration has not invaded the extra-cervical tissues or involved the large cervical artery. A persistent postpartum flow, in association with a firmly contracted uterine fundus would naturally arouse a suspicion of the presence of a cervical laceration, and this would be strengthened, in the absence of a direct ocular and digital explora-



FIG. 5.—Posterior laceration of the cervix uteri, with slight transverse splitting of the os.





**FIG. 6.**—Incomplete transverse splitting of the cervix uteri, with hypertrophy and erosion of the anterior lip.

tion, by protracted involution and the presence of a certain amount of pelvic cellulitis.

The symptoms of a neglected cervical tear are, however, very characteristic. They include an exhaustive menorrhagia and metrorrhagia which may assume alarming proportions; a troublesome leukorrhea of the familiar, thick, viscid variety, occasionally streaked with blood; dyspareunia and tenderness to the touch, due to the granular and eroded condition of the cervix; pelvic soreness and pains; a localized feeling of weight, and interference with locomotion due to a sense of loss of support. There is a backache, frequently confined to the lumbar region, but which may extend from the sacrum to the base of the skull; at times this is very intense. The pelvic pain is, in large part, due to a coexistent pelvic lymphangitis and lymphadenitis. The general health breaks down and the patient sinks into a condition of semi-invalidism characterized by menstrual irregularities, permanent sterility due to the profuse and acrid leukorrhea and in part to a distortion of the cervical canal, and an immense number of reflex neuroses and functional nervous disorders.

The reflex manifestations are protean in their variety. They include cardiac palpitation and irregularity, gastric disturbance (a very common reflex in this condition), insomnia, a sense of weight or pressure upon the top of the head, and distinct localized pains over the body. Frequently severe headaches are complained of, referred especially to the vertex and nuchal region. The eyes are very often affected, and burning, pain, asthenopia, and eyestrain are not infrequently to be noted. Neuroses of the nose and throat are of common occurrence, and Anderson<sup>14</sup> reports a case of long-continued asthma which had resisted all treatment, but which was promptly cured when a cervical laceration was repaired.

THE PATHOLOGY OF OLD CERVICAL LACERATIONS. Owing to the heavy, subinvolted condition of the cervical tissues, the constant friction with the vaginal wall, and the profuse and acrid leukorrheal discharge, the cervix soon becomes eroded, everted, and the seat of a granular degeneration and cystic formation. Its parenchymatous structures become hyperplastic, indurated, elongated, and enlarged,

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<sup>14</sup> Harper Hospital Bull., 1898, p. 110,

while the uterus itself is the seat of a marked subinvolution. This sooner or later results in a sagging of the organ followed by a backward displacement. This retroflexion is frequently associated with a retroversion and not rarely a salpingitis develops.

The cervix is velvety to the touch, the os is patulous or exists as a fissure or as radiating fissures. At times the dilatation is so marked as to permit the introduction of the tip of the finger almost to the inner os. The granular erosion bleeds freely, and is not infrequently the seat of numerous Nabothian cysts.

The erosion of the os externum or, as it has been called, the "catarrhal patch" (Penrose) or "cervical folliculitis" (Pryor), is invariably the cause of a profuse cervical catarrh and leukorrhea. It results from the eversion of the two walls produced by the laceration, which brings the cervical mucosa in contact with the vaginal walls and acrid vaginal secretion. The resulting endometritis shows no tendency to disappear, but is perpetuated by the persistent irritation. Ruge, Veit, Hart, Barbour, and others have revealed the true pathology of the erosion. They have demonstrated beyond controversy that the eroded area is covered by a thin one-celled epithelial layer, and that it is in no sense an ulceration. It is produced by a proliferation of the cervical mucosa, and may cover an area of one or two inches in diameter. The epithelial cells are narrow and long and have a palisade-like arrangement. The surface of the catarrhal patch is thrown into numerous folds producing glandular recesses and processes which give the characteristic granular appearance and velvety touch of the patch.

The Nabothian cysts are distributed beneath the mucosa deeply in the diseased cervical tissue, and must be regarded, as Goldspohn<sup>15</sup> has indicated, "not merely as hypertrophied glands, but as a graver feature, tending toward malignancy." Tyler Smith has estimated that no less than ten thousand of Naboth's glands exist in the normal vaginal cervix. When they undergo cystic change they vary in size from a mustard seed to a pea, and give the sensation of small shot embedded in the cervix. Puncture of such a vesicle permits the escape of a drop of gelatinous fluid. Sooner or later this catarrhal condition invades the higher tissues and terminates in a general

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<sup>15</sup> Jour. Am. Med. Assoc., March 14, 1896.

chronic cervical catarrh with subinvolution of the uterus and chronic endometritis.

In her efforts to restore the original condition of the lacerated cervix Nature does the best she can by filling up the fissures with fresh connective tissue which is organized from the granulations that are thrown out. This cicatricial tissue has a low grade of vitality, is occasionally unduly sensitive to the touch, and is prone to undergo degenerative changes late in life. It is inelastic and acts as a foreign body in the cervix. To its presence must be ascribed many of the reflex symptoms of which the patient complains.

**THE DANGER OF NEGLECTED LACERATIONS.** A cervical tear is not a trifling matter by any means. The difficulty of recognizing the condition at the time of its occurrence and its obscure position have done much toward the cultivation of the popular negligence as to its treatment. There are positive dangers that are attendant upon it, however, and these should receive careful attention. If the tear is of any size at all, a vascular and quite susceptible portion of the uterus is made bare for the absorption of septic germs. A pelvic cellulitis not infrequently is caused in this way. While the lymphatics in the cervix are not so numerous as they are in the vagina or in the body of the uterus, they are sufficiently abundant to be responsible for a large number of cases of puerperal sepsis. Infection taking place at this point may develop within a few days as a general or localized peritonitis—usually the latter; it may manifest itself as an inflammation of the cellular elements of the broad ligaments, with or without subsequent abscess-formation; or it may be at first confined to a limited area, as a phlebitis of the uterine veins, which later, extending to the veins of the legs, develops into a phlegmasia alba dolens. These complications are more prone to follow the extensive tears involving the vaginal vault.

Again, any septic inflammation of the genital tract of the puerperal woman delays involution of those parts. A torn and imperfectly united cervix results in a subinvolution of the uterus to varying degrees, with a coexisting endometritis and metritis. Following upon this sequel will be a long and serious train of developments that may invalidate the patient for life or subject her to a serious abdominal operation.

Finally, as to the development of cancer. There is an undoubted relationship, first noted and enlarged upon by Emmet, existing between laceration of the cervix and malignant disease of the uterus. Cancer in woman occurs most frequently in the womb and in parous women. In the uterus, the cervix is the most common seat, but this rarely, if ever, occurs in nulliparæ. The cancer almost invariably commences in the cicatricial epithelium of the infravaginal cervix or in the cylindrical cells of the cervical canal. I am not an alarmist in any sense of the word, and I do not think that any but the smallest percentage of the cervical tears becomes the seat of carcinomatous degeneration. It is undoubtedly true, however, that carcinoma of the cervix rarely develops in any save a lacerated organ. If the frequency of the development of the malignant change was greater than it is, I believe I would advocate not a restoration, but a complete amputation of the torn cervix as a strong prophylaxis against the appearance of cancer.

**THE TREATMENT OF CERVICAL TEARS.** Two courses of treatment are open. The first includes a course of topical applications to the eroded surface and measures directed toward the relief of the cervical catarrh and uterine subinvolution. The second consists in some form of operative procedure, namely, trachelorrhaphy, tracheloplasty, or amputation.

In very many instances the cure of the catarrhal patch and associated catarrh of the cervix will relieve the symptoms. If this can be accomplished an operative procedure may be avoided. With many gynecologists, I believe that the operation of trachelorrhaphy has been greatly abused. It should be resorted to only in the case of the severer tears after a restorative treatment has been instituted for a reasonable period of time. Pryor,<sup>16</sup> in writing upon the abuse of trachelorrhaphy, gives the indications for the primary operation concisely as follows: "Trachelorrhaphy I would limit to the immediate operation for hemorrhage, and to those cases of tear through the cervix from the internal os out to the vaginal junction—cases of true extraperitoneal rupture of the uterus."

It is just as well to state here that the term "trachelorrhaphy," or "suture of the cervix," should be limited to the immediate repair

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<sup>16</sup> Am. Jour. of Med. Sci., June, 1894.

of a laceration, while "tracheloplasty" is more properly restricted to the secondary plastic operations of Emmet, Newman, and others.

*The Primary Operation—Trachelorrhaphy.* There has been, and still is, a considerable diversity of opinion as to the advisability of an immediate restoration of a cervix at the time of delivery. It is very generally admitted that when such an operation has been performed, it not infrequently happens that union is not secured owing to the devitalization with sloughing of the tissues from pressure and contusion at the time of labor, and the difficulty of maintaining subsequently a favorable condition for wound-repair. R. L. Dickinson<sup>17</sup> very properly maintains that just after delivery the cervix is so swollen and distorted that it is impossible accurately to coapt the torn parts, and, in addition, the excessive bleeding obscures any work that may be attempted. It is also not desirable at this time to administer an anesthetic for obvious reasons. Dickinson would limit the immediate suturation, therefore, to those cases in which there is hemorrhage which is not controlled by the hot douche or ergot.

The favorable time, in his estimation, for the repair of the cervical laceration is from the third or fourth to the fourteenth day after delivery, and this might then be very appropriately termed the *intermediate* operation. B. C. Hirst<sup>18</sup> likewise advocates the restoration of the cervix after the fifth day, and preferably at the end of the first week. D. Prague<sup>19</sup> believes that the operation during the continuance of the lochia is contraindicated except in some unusual cases. If the primary suture be required it should preferably be of the heavy chromicized catgut. The operation has but two objects in view, namely, the control of hemorrhage and, as far as possible, the accurate coaptation of the divided structures.

The after treatment consists merely in the maintenance of as aseptic a condition as is possible under the circumstances.

*The Secondary Operation—Tracheloplasty.* Many operators insist upon a late operation for cervical repair. Manton<sup>20</sup> states

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<sup>17</sup> N. York Med. Jour., March 26, 1904.

<sup>18</sup> Proceedings of the Phila. Co. Med. Soc., vol. xxv, No. 2, p. 55, Feb. 29, 1904.

<sup>19</sup> Jour. Am. Med. Assoc., Oct. 31, 1903, p. 1071.

<sup>20</sup> Physician and Surgeon, Dec., 1898.

that "several months should ordinarily elapse before operative measures are resorted to," and that "all immediate interference on the part of the surgeon-accoucheur is to be deprecated and condemned." Most authorities hold that at least six months should elapse after the confinement. This affords time for proper local treatment and for full involution of the uterus to occur. Personally, I would not wait as long as this unless there were very urgent reasons for so doing.

The *preparatory treatment*, which should always be instituted, embraces rest, as far as is possible, regular daily hot (118° F.) vaginal douches, applications of iodine (Churchill's tincture) or of equal parts of iodine and carbolic acid (Battey's solution) followed by tampons of ichthyol and glycerin or of boroglyceride, and the systematic use of saline laxatives. Cystic degeneration of the cervix should not be treated by puncturing the cysts, according to Pryor,<sup>21</sup> but such cervixes, which are especially prone to malignant changes, should be amputated. This, I think, is true only when the cystic change is very marked. In mild cases puncture and cauterization with carbolic acid will give excellent results.

Pryor further defines as a pathologic laceration of the cervix requiring tracheloplasty "any tear which is of sufficient severity and degree to implicate the circular fibers of the cervix sufficiently to cause a modification in the shape or position of the uterus. A tear to do this must sever most of the sphincter fibers of the cervix at one or more points."

The *contraindications* to the operation are positive, and the chief among these is the presence of extra-uterine inflammatory trouble, a perimetritis and parametritis, including disease of the tubes and ovaries. The danger here would be the rekindling of an acute inflammation which might speedily become general, or the rupture of a pre-existing pyosalpinx with the production of a local or general peritonitis. A close examination of the pelvic viscera prior to the operation will eliminate this danger. Other contraindications include the presence of marked uterine subinvolution, a grave form of endometritis, gonorrheal or septic infection of the genital tract, and the presence of pelvic growths of any kind.

The *instruments* necessary for the proper performance of

<sup>21</sup> Loc. cit.

Emmet's operation—which is the one follows: A Sims speculum; a double ten strong, slightly-curved, right and left bistoury; half a dozen hemostats; a blue a dozen Emmet's cervical needles, steel pressure hook; two long dressing-forceps; uterine dilator; a shot-compressor; piece of silkworm-gut; a large curved needle to hold a leg-holder or lithotomy crutch; and

*Technic of Emmet's Operation.* The patient is placed on her side with her hips supported on a Kelly pad at the edge of the table. If the operator prefers the Sims' semiprone lateral position. After the parts are exposed, the cervix is dilated, if this canal quickly but thoroughly curette is introduced and the traction-stitch is introduced in the median line antero-posteriorly through the cervical canal, and the length; the thread is then divided and one end attached to each lip, and by means of the forceps drawn down and the lips well separated.

With the bistoury the area to be removed is being taken to preserve a strip of unbroken tissue of either lip to maintain the central coaptation into apposition (Fig. 7). The outer lip is divided along its entire external circumference of the lip down to the angle between the upper and lower lip. This is grasped by the forceps and removed as one unbroken strip. The under lip is then exposed, obscuring the field by bleeding from the wound. Denudation is made upon the opposite side and remove thoroughly the cicatricial tissue and the two surfaces should be repeatedly approximated and accurate coaptation when the sutures

The latter are inserted as follows: The curved cervix-needle is threaded with silkworm-gut into the upper lip near the angle, above the area of the denudation; it is made to traverse



transversely and emerge upon the undenuded mucous strip; carried downward it is reintroduced at a corresponding point on the undenuded strip of the under lip, and is brought out on the mucous membrane of the vaginal aspect of the cervix at a point corresponding to its point of entrance on the upper lip. The other sutures, two or three in number, are placed at intervals of about three lines, starting on the mucosa of the vaginal aspect, being buried under the entire width of the denudation, and emerging on the central mucosa to follow a reversed course on the lower lip. These sutures may occasionally be more readily introduced if a needle is threaded at either end of the silkworm-gut, and both needles are introduced from the central mucosa to emerge upon the vaginal aspect of the cervix (Fig. 8). A similar line of sutures is introduced upon the opposite side of the cervix. These sutures are drawn taut, after the blood-clots have been washed away, and one by one are secured snugly by means of perforated shot which are clamped close to the vaginal mucosa of the cervix without making undue tension (Fig. 9). The free ends of the sutures on one side are gathered together and secured at their distal ends by a larger shot, which hangs without the vulvar orifice. This facilitates the removal of the sutures. The process is repeated upon the opposite side, after which the patient is removed from the operating-table. The sutures may be removed through a Sims' speculum on the eighth to the tenth day.

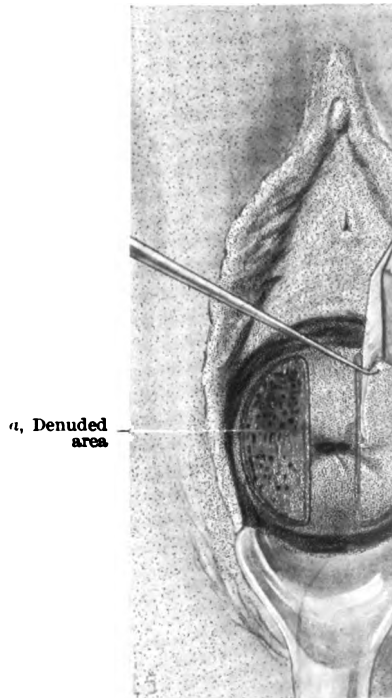
A unilateral tear, as well as an incomplete laceration, should both be converted into a bilateral split by means of scissors. The closure of both sides is then carried out as indicated above. Multiple or stellate lacerations are best treated by amputating the deformed cervix.

*Schroeder's Operation.—Resection of the Cervix.* In cases in which there is more serious involvement of the cervical tissues, Goldspohn<sup>22</sup> recommends the operation suggested by Schroeder, of Berlin, for excision of the catarrhal mucous membrane from the cervical canal. It is as follows:

“(1) Exsection of the cicatricial wedge at the bottom of each tear by two suitable incisions which meet near the internal os, forming an acute angle with each other. When there is only a

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<sup>22</sup> Loc. cit.



**FIG. 7.**—Emmet's operation, showing the met

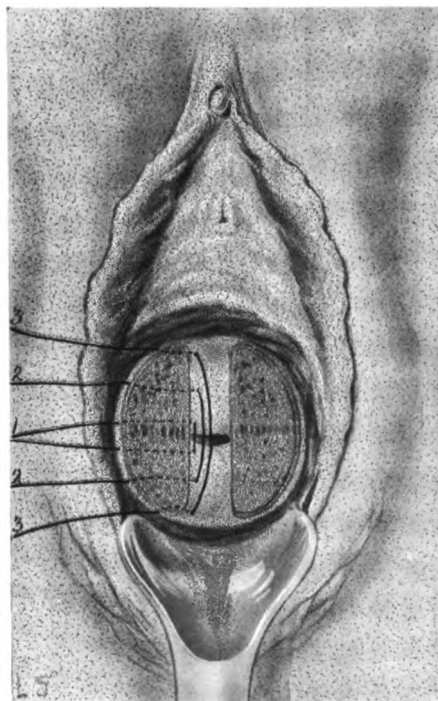
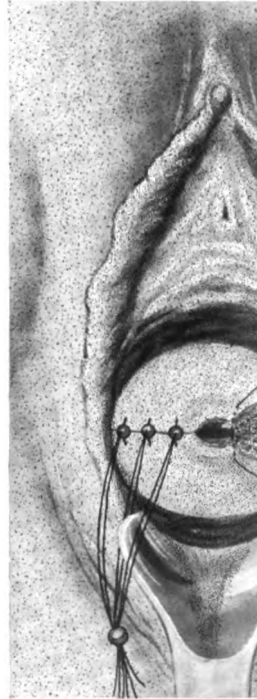


FIG. 8.—Emmet's operation, showing the method of introducing the sutures.



**FIG. 9.**—Emmet's operation, showing the man

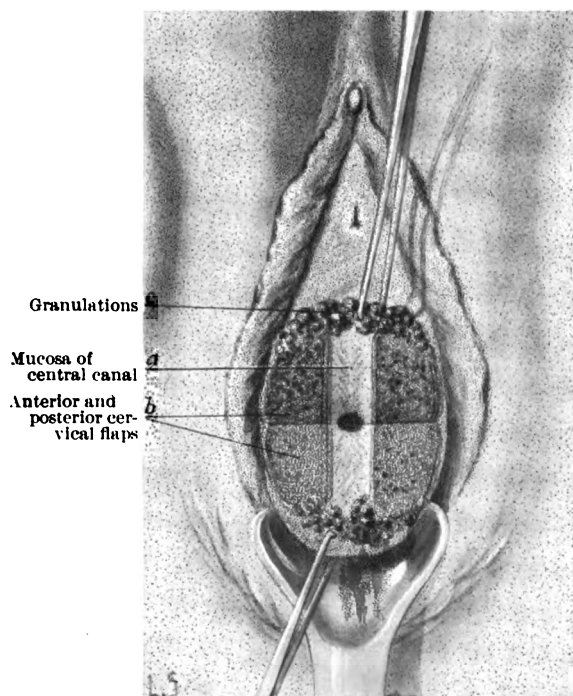


FIG. 10.—Amputation of the cervix in cases of grave laceration, the two flaps being held apart by tenacula, after splitting of the cervix.

unilateral tear and diseased cervix be removed, then one simple tempo made in the cervix at a point opposite two cervical flaps thus made apart cervical canal becomes accessible.

" (2) A cross-cut is then made to about one-eighth or one-quarter boundaries of the cervix, and of the mucous membrane and all induced. This cut is made as high up in the cervix to remove all diseased parts and still admit of the canal. From this incision downward to the mucous membrane and with it all the diseased parts, with all the diseased follicles in it, a hollowed-out flap of the soft and of the portio vaginalis is left. The flap is sutured by four itself, and its end sutured by four projecting shoulder above (and created a new one).

" (3) The other lip is next treated.

" (4) Finally, three or four flaps are produced on each side similarly to the first.

By this method a short and broad canal is made, the external portion of which is covered by the thelium which will not degenerate, the mucous membrane does, and stenosis is avoided, as it may be by the Emmet operation.

*The Sänger Operation.* Max Sänger's operation of flap-splitting (*Lappen-trachelorrhaphie*) is as follows: Each lip of the cervix is incised with forceps; three points are located by the finger in the posterior lip where the new cervical mouth is to be situated, and the incision is made at an angle of 45 degrees to the angle of the fissure. The incision running along the lateral margin of the mucous flap of the cervix is made up toward the median line. After the flap is divided the flap is drawn at its lateral angle

<sup>22</sup> v. Volkmann's Samml. klin. Vortr., 1884, p. 100.

the external os, and the denuded triangle is brought together by sutures running vertical to the long axis of the canal of the cervix. The sutures are knotted toward the vaginal cervix. The two lower sutures embrace the separated flap which has been drawn inward, and the cervical canal is not punctured, but remains free from sutures.

*Newman's Operation.* Newman,<sup>24</sup> of Chicago, has devised a plastic operation which is designed to replace the older methods described above. It is a variety of amputation of the cervix. The technic is as follows:

"The blades of the bullet-forceps are placed within the cervix so that their points are directed laterally from within outward." This brings the traction upon the inner area of the cervix and leaves the anterior and posterior walls free for making the flaps. The cervix is then transfixed by a special knife, and a clean cut is made from above downward, first in the posterior lip. "The anterior lip is transfixed in a similar manner about one or one-and-a-half centimeters in front of the other and cut in the same way. The intervening plug of diseased tissue is then removed by a single cut or two of the curved scissors, the bullet-forceps having been changed to a lower position to allow of this. If the flaps have been properly made they will now fall together and inward, so as to assume the appearance of a normal cervix." Simple suturing will retain them in apposition. This method is somewhat similar in its results to the Schroeder operation.

*Amputation of the Cervix.* There are some of the more severe bilateral lacerations of the cervix, with marked eversion and erosion, which will resist all topical treatment, and which can only be cured by amputation of the hypertrophied and redundant cervix. This is also true of all multiple or stellate lacerations, which can properly be treated only by amputation of the deformed organ. As Hyde<sup>25</sup> has indicated, "when extensive alterations have taken place trachelorrhaphy is out of the question, since to remove all the diseased tissue would call for an unattainable amount of nicety of dissection." The operation of amputation is not likely to be followed by stenosis of the canal, but occasionally, as has been reported

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<sup>24</sup> Jour. Am. Med. Assoc., Sept. 10, 1898.

<sup>25</sup> Pacific Med. Jour., Jan., 1902.

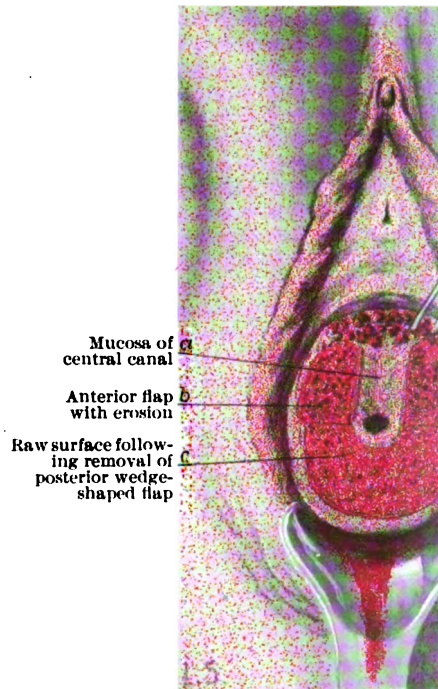
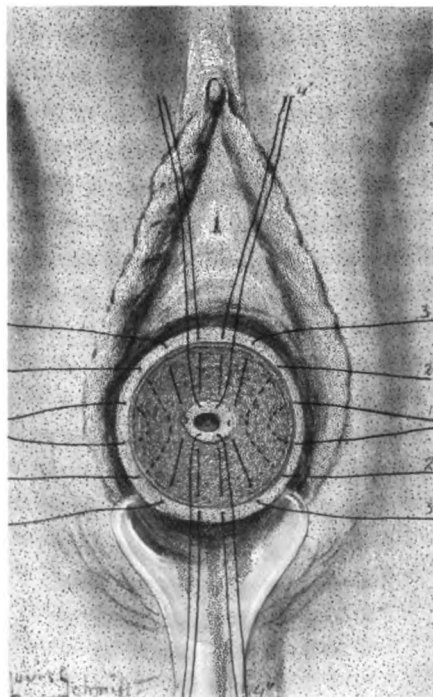


FIG. 11.—Amputation of the cervix in cases of grave removed ; the anterior flap is in

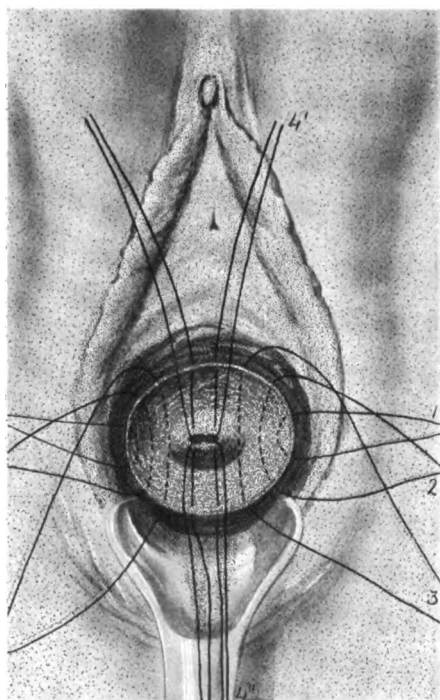




**FIG. 12.**—Amputation of the cervix in cases of grave laceration. Both flaps have been removed, and the sutures are introduced, ready for shutting.



FIG. 13.—Congenital hypertrophic elongation of t  
of amput



**FIG. 11.**—Conical cervix after amputation. Sutures introduced and ready for shotting.

recently by Boissard and Coudert, sequent pregnancies, the cicatricial forces.

The technic of the operation is as far up as the vaginal junction then grasped by bullet-forceps and an aspect extending from the angle of on the opposite side. The incision remove a wedge-shaped portion of the wedge at the angle of the bilat is treated in a similar manner (F introduced from the vaginal to the median line on the anterior lip; the and two or three sutures are passed sues on either side as in trachelorrh of suturation the cervical canal is m closed as in Emmet's operation. Al

*Hypertrophic Elongation of the* in this discussion of the plastic surg condition which for its cure requires is the rare deformity known as "h was recognized by Huguier as early affect either the infravaginal or th cervix. The infravaginal elongatic the peculiar long and slender conic may attain a length of from two to t common in, if not absolutely confi condition is generally, but not abso tion. Elongation of the supravagina parous women, and results from th labor. Both of these conditions requ the restoration of the uterus to its n or more of the conical organ may mucosæ of the vaginal and cervical usual manner (Fig. 14).

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\* L'Obstet., Jan., 1904.

## THE MANAGEMENT OF CHRONIC CYSTITIS IN THE FEMALE<sup>1</sup>

BY DANIEL H. CRAIG, M.D.

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EXPERIENCE in gynecology shows no branch of the work in which the profession as a whole does so much empirical prescribing and persists in it so long in spite of little, evanescent, or no progress, as in inflammations, especially the chronic forms, of the bladder, and it shows no organ within the female pelvis so inadequately considered. The anatomy of the female urinary organs is so essentially different from that of the urinary organs in the male, and the interrelation with the genital organs is so intimate that, as I have often said, the diseases of the uropoietic system in the female, especially the surgical diseases and those requiring local, that is, cystoscopic, treatment or investigation, come logically under the domain of gynecology.

I believe that the reasons for this inadequate treatment are the insufficient instruction in years gone by, a persistence in the ways formed in early practice and in the medical school, and the fact that in the minds of most who have not yet tried them an exalted idea of the technical difficulties in the employment of modern, exact, scientific methods exists—which has no existence in reality. This is, in a measure, salutary, since it will inevitably lead physicians, when they do resort to the local treatment of lesions of the bladder, to do so well, carefully, aseptically, and with good results. Surgical asepsis is an absolute essential, and is, fortunately, easily secured by very simple means, with the expenditure of but a few minutes, and can be achieved anywhere, at the office, or at the patient's home, as easily as at the hospital. Do not understand me as advocating cystoscopic treatment of every case of cystitis in the

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<sup>1</sup>Read at a meeting of the North Bristol Massachusetts District Medical Society, Norton, Massachusetts, June 21, 1906.

female. Such is not only not my d  
bad practice.

The treatment of a cystitis, as c  
to be permanently successful, must  
etiology. Any other line of treatme  
and, in certain cases, in which imme  
importance, may be justifiably ins  
understanding that it is neither scie  
can desire less than I to sacrifice  
patient to the interests of science,  
majority of all cases the truly sci  
successful treatment.

The bladder is an intolerant o  
the normal characteristics and react  
very quickly react upon it so as to ren  
a patient comes to the physician i  
convictions to do nothing for her ur  
has been thoroughly mastered, and y  
in every case not urgently demandin  
When such relief is demanded every  
plish it without so modifying pre-e  
as to obscure the etiology, as, for ex  
secretion plays an etiologic role.

It was to have been expected that  
of the diseases of the female bladder  
session of better instruments should  
our heretofore accepted ideas of ves  
to this one of the most surprising  
of our ideas as to etiology. Those  
had stood in the relationship of exci  
at once as only predisposing causes,  
were found, in the vast majority, if n  
pathogenic organisms acting upon a  
predisposing causes. This discovery  
former failures to cure and the fre  
after apparent cure.

Among the predisposing causes tl  
by Dudley as follows:

(1) Pathological urine; (2) retention of urine; (3) tumors; (4) foreign bodies, especially stone; (5) trauma, including rupture of a pelvic abscess into bladder; (6) any local or systemic cause of congestion, or blood stasis; and (7) rheumatism and uric acid diathesis.

The last two of these causes are so broad as to cover a multitude of sins and yet, vague as they seem, they and they alone seem often to be the only coöperating agency acting with the actual exciting cause.

Of the actual exciting causes of cystitis *Bacillus coli communis* leads all others in frequency, although it is usually less disastrous in effect than the tubercle bacillus or the gonococcus. The staphylococci are occasionally found in pure culture, but they usually figure in mixed infections.

The practical bearing of this discovery<sup>4</sup> of the relative value of the predisposing and exciting causes is interesting and clinically important. Looking back to the days before the introduction of exact scientific methods of local treatment it shows how success was achieved, even if not so often as now. While the point cannot be regarded, perhaps, as finally settled, the consensus of opinion seems to be that the simple introduction of pathogenic organisms alone is not sufficient to produce cystitis, and no more are the predisposing causes able to cause it in the absence of infection. In the presence of the predisposing causes alone, and in the absence of infection, we at most get a hyperemia of the whole or a part, especially the trigonum, of the bladder, but no actual inflammation in the true pathologic sense of the word. This constitutes the so-called irritable bladder, although cystoscopic examination often reveals very different causes for what has for years been called an irritable bladder, as will be seen in Case I herewith reported, in which this diagnosis of irritable bladder had been made many times by many men.

This necessary conjunction of predisposing and exciting cause shows why the older therapeutics was successful up to a certain point, beyond which it was utterly impotent. Given a case in which the bladder had been prepared for bacterial invasion by the long continued irritation of its mucous membrane by a pathologic urine: the administration of the acetate or citrate of potassium or the

various lithia salts or waters relieve predisposing cause, and hence render it more or so lessened their virulence more comfortable. It failed of permanence and could not at the same time remove both the causes.

Then came another error: *A. coli communis* was the principal cause of cystitis came the explanation of the relation with an acid urine. For man was not made except in the event when freshly passed. But the urine in cystitis in which *Bacillus coli communis* in pure culture, and it is generally this organism constitutes the principal cause. However, its coöperation with the acid urine. Urine containing this latter organism does not destroy the pathogenicity of the acid, showing very clearly that, as above, in thinking that merely changing the acid to alkaline was going to remove the exciting cause.

All that has been said regarding acidity applies with equal force to the action of acids and the benzoates, and to the causes as are systemic or mechanical.

Just one point more as to the cause. He observed an additional predisposing cause, dilute urine of low specific gravity, and insufficiency in those cases in which the amount of total urinary solids is considerably less than 35 to 50 grams. Dudley unconsciously he says: "The writer has occasionally observed the appearance of irritation of the bladder, sometimes times a day, for several weeks, of course, on the use of one-twentieth of a grain suppository of calomel, or artificial mineral waters or of any other known that calomel is one of the



the percentage of total solids excreted by the kidneys, and Ogden assures us that the copious drinking of pure water very greatly increases this percentage of total solids, provided it be not too long continued; he advises an intermission of one or two weeks after copious drinking has been practiced for three weeks.

Much may be done in the way of diagnosis in addition to or in the absence of chemical and bacteriologic analysis of the urine. In the first place, it should be borne in mind that the particular kind of organism present in a given case bears no necessary relation to its gravity or to the severity of symptoms. Indeed, the most urgent symptoms may supervene in cases in which cystitis, in the true, scientific acceptation of the word is absent; I refer to cases of hyperemia of the trigonum, in which the element of infection and actual inflammation are still absent. If the expression may be allowed, this hyperemia of the trigonum seems to be the result of certain, usually mechanical, predisposing causes alone. As a general rule, but not without notable exceptions, it may be said that those cases of cystitis due to the tubercle bacillus and to the gonococcus are severe.

Now to return to the purely clinical diagnosis. In any but young virgins gonorrheal infection must always be considered, and in considering it one must always remember that in the so-called latent cases the vulvo-vaginal symptoms and signs may have attracted little or no attention and may have long since disappeared. Gonorrheal cystitis, however, is practically always due to an upward extension from a gonorrheal urethritis, and a careful milking of the urethra will usually produce a slight drop of pus, either from the urethra or from Skene's glands; this should always be regarded as suspicious, although not as positive, as may be shown by the following case:

CASE I. S. 5, No. 308. First came under my care in the fall of 1901. She had had a dilatation, curettage, trachelorrhaphy, and perineorrhaphy at the Free Hospital for Women in May, 1898, with perfectly satisfactory result. At the time of her first visit to me, three and one-half years after the above operation the diagnosis was multiple fibroids of the uterus. I operated upon her June 11, 1902, removing a medium-sized, three-lobed fibroid from the posterior uterine wall and two tiny nodules from the fundus. Her

recovery was perfectly satisfactory. I 16, 1906, when she complained of friction, the pain accompanying the passage all at the end of the act. She had 1 urinary organs on two occasions. Ph the following data: The abdomen was kidney was palpable nor tender. I was seen coming from the urethra and siderable quantities. Eversion of the that pus came from the deep urethra a My long familiarity and intimate kn me at once to suspect some cause other scope was carefully introduced about the bladder and the urethra inspected drawn. About one inch from the exte from which the pus came freely. I heretofore quiescent, diverticulum or the history of hematuria, a deep ulcer the urethra. A bead of nitrate of sil probe was pressed deeply into this sac she was discharged cured. She was has remained free from all symptoms she was pregnant (which she was not)

This is only one of many cases familiarity with the patient a negative would be necessary to exclude gonorrhoe

Montgomery calls attention to a p of tuberculous cystitis which I have case, namely, that in examining the cystitis, when the disease is due to tub from the sudden withdrawal of deep h resulted from the pressure itself. So this is true of no other form. Such s of grave importance, because too impl in bacteriologic tests, unless, when pos by coexisting clinical data. Walsh, sively shown that tubercle bacilli ma kidneys in numbers sufficient to be e

tuberculous focus is pulmonary—absolutely no involvement of the urinary organs. The fallacy of negative bacteriologic findings, unless many times repeated, is too well known to need mention.

One other set of symptoms is of the greatest value in determining the location of the disease. Many patients come to us with a ready-made diagnosis of cystitis and merely ask us to prescribe. Don't do it. Make your own diagnosis in every case and so avoid errors, sometimes important errors. The chronologic relation between the pain and the act of micturition is a great diagnostic aid. When pain is almost constant and bears but little relation to micturition, or is temporarily relieved thereby, and extends considerably up into the loins on one or both sides of the abdomen, suspect rather the ureters or kidneys than the bladder. When pain follows the act of micturition, especially if it be spasmodic in character, suspect the bladder itself. When the pain is synchronous with the act of micturition always suspect the urethra. Many cases in which the latter relationship obtains, which come with a self-made diagnosis of cystitis, prove upon inspection to be urethral caruncle. Of course, various combinations of two or all three of the foregoing types may exist in which the disease is not strictly confined to one region to the exclusion of the others.

So many and such excellent papers have appeared within the past few years dealing with the pathology and bacteriology of cystitis, with its various forms of ulceration, etc., that it is unnecessary to go into those subjects here and more particularly since I have nothing new nor of practical importance to offer along those lines. To come now to the real subject of the paper, the management of cystitis in the female.

First let me again urge that you not accept the patient's diagnosis without confirmation. Physical confirmation must often be negative, but none the less I insistently urge that in every case in which such a course is possible one should first convince himself, at the very least, that the symptoms are not due to some condition which, upon careful physical examination, proves to be obviously other than cystitis, such as gonorrhoeal urethritis or caruncle. When no obvious cause other than the cystitis is found and symptoms are urgent, prescribe a preparation of hyoseyamus or a suppository containing belladonna and ichthyol, with or without an

opiate, according to the urgency of t will modify very little if at all the nary secretion. Instruct the patien ordinary precautions as to exactitu the twenty-four hours during which to vary her natural habits as to diet as little as possible. By this mea valuable information as to one of th cystitis, namely, the predisposing c if such predisposing cause is the re condition, and if it be not due to the valuable information of a negative c of more thorough physical explora treatment which fails to discover an and the exciting causes must result

Assuming that the urine shows predisposing cause, combat it in th been accustomed, that is, if the uri time-honored and unequalled aceta usually prescribe this in combinatio tincture of hyoscyamus, which latte of urinary origin without producin due to opium and its derivatives, an tion of a dangerous drug addition will later be shown, cases usually promptly as to minimize the danger an alkaline urine the therapeutic benzoate of sodium is, of course, equ

With either of the above cours advise á free, or even a forced, inges water, medicinal waters being abso best be accomplished by prescribing small individual doses to be taken i this manner relatively large quantiti the patient without her realizing the t mentioned, in which a persistently l figures as a possible predisposing ca a given number of glasses of water i

to appeal to the patient as efficient medication, and success can only be achieved by the administration of a placebo, at frequent intervals, with strenuous and insistent directions as to the necessity of dilution with water.

Of course, it is obvious that when the predisposing cause is other than urinary, appropriate treatment of the offending organ, be it kidney, ureter, bowel, uterus, appendage, or what not, is equally a necessity, but can obviously not be considered in detail in this paper.

Having the predisposing cause well understood and under appropriate treatment, what can be done for the actual exciting cause? the infecting organism. Fortunately for us, as well as for our patients, the specific forms of organisms do not each require their own especial, specific germicide. Also, fortunately, we possess a means of rendering the urine mildly germicidal far in excess of our ability thus to influence the other viscera and emunctories. I refer to the employment of the various pharmaceutical agents which liberate formaldehyde into the urine. Some one of these preparations of hexamethylene-tetramin, sold under various shorter names, mostly trade names, should always be administered in connection with every other form of treatment, both of the predisposing and the exciting causes. It may not exert a sufficiently powerful action completely to suppress the infection, but we have every reason to believe that it helps in practically all cases. To be efficacious it must be used in full therapeutic dosage, which must be determined for each individual. Starting with a medium dose the amount should be rapidly increased until the physiologic signs of headache, or at least discomfort, appear; after which a short intermission, until the disappearance of the headache, should be allowed, whereupon the drug should be resumed in a dose very little less than the full dose.

Under this double regime the patient should be closely observed for a few days until distinct improvement is noted or until we are satisfied that no improvement is to occur by such methods. Should improvement be observed, persevere in this same treatment until complete cure has resulted and has been established for at least ten days; then discharge the patient only provisionally, with the understanding that she is to return upon the slightest recurrence, for the

purpose of establishing a diagnosis remains uncured. Should improvement in systemic treatment, do not waste time with applications of similar drugs after progress has been made, but proceed at once as you would with a mucous membrane, namely, to local treatment, a consideration of the treatment of the bladder by means of the cystoscope.

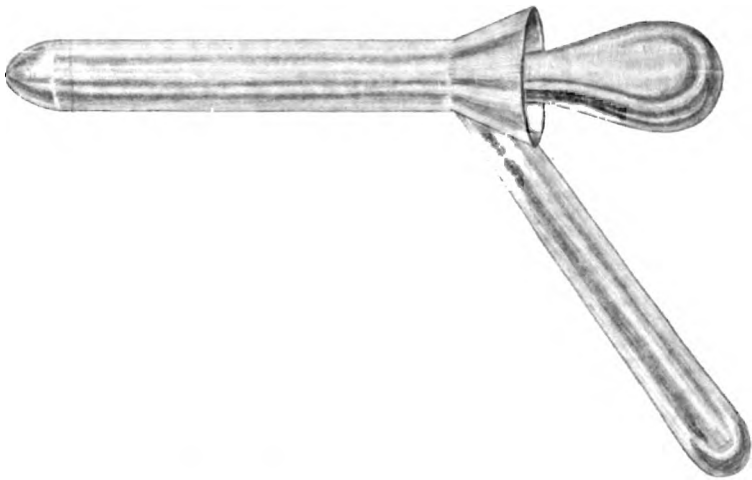
I wish to preface the consideration by a few generalizations. The first is that it must be done with efficiency; second, it must be done as an operation; and fourth it had better be done in an efficient or unclean manner than in an inefficient one, dependent of your own ability properly to perform your reputation and the respect of your colleagues. During the past few years, from the careless and inefficient use of the catheter, times past similar harm resulted from the use of the catheter. Yet at the present time even the most dangerous, thanks to the abolition of the catheter, is done in the dark and to a due observance of the rules in time with the cystoscope, at least in the female.

As to instruments: The simplest is a straight tube, with a handle and obturator (Fig. 1). Those bearing evacuating tubes, which are used during a prolonged use, during the use of the bladder, are in no case necessary or of any use. In place, such secondary tubes lessen the efficiency of the operation, except in long operations the collection of urine and even then can usually be disposed of by the catheter. If not possible, I have always found that the catheter demands. A linen ureteral catheter is used through the cystoscope; the cystoscope is again reinserted beside the catheter; a small rubber tube does not collapse by siphonage, or an evacuating bulb, or by moving the cystoscope—often a n

Cystoscopes carrying lighting devices are, in my opinion, an unnecessary expense and care. They are more complicated, hence more difficult to keep clean, and they are very likely to fail when most needed. A small kerosene lamp will give all the illumination needed for the ordinary treatment of cystitis. Much of the success, however, of bladder illumination depends upon the head mirror. The ordinary laryngoscopic or ophthalmoscopic mirror gives very unsatisfactory illumination. Its central opening is too small and its focus too short. I employ a mirror with a large central orifice, and a focal length of twelve inches. This will concentrate a strong light within the bladder from a small hand lamp. Of course, it goes without saying that, while for office or hospital work the electric headlight may be serviceable, it is obviously impracticable for the family physician's use at the homes of most of his patients. Since there is much to be gained, here as elsewhere, in thorough familiarity with one's equipment, I have preferred to use instruments that can be used with equally good results in all places and at all times.

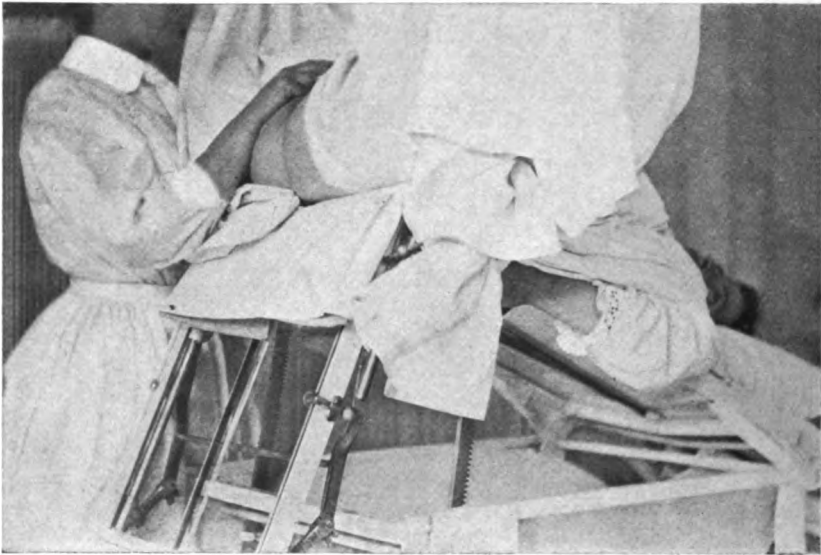
The position of the patient was mentioned. It was at first customary to do cystoscopic work with the patient in a much exaggerated lithotomy position (Fig. 2). For growths upon the fundus and anterior bladder wall, this is still best, because even a considerable collection of urine in the bladder does not interfere with the work; but otherwise I find the exaggerated Sims position or the genupectoral posture preferable. The exaggerated Sims (Figs. 3 and 4) position can be used for practically all cystitis cases except in very stout women in whom nothing but the genupectoral (Figs. 5 and 6) position is satisfactory. It is the only position which offers no support to the heavy, ponderous abdomen and its contents.

It is extremely easy to teach, especially easy to demonstrate, the technic of cystoscopy, but I have never faced a harder problem than that of teaching the recognition of many of the less manifest bladder lesions through the cystoscope. It is manifestly impossible for two persons to see through one cystoscope at the same time, and it is almost impossible to be certain when one person releases and another takes the cystoscope that the field of vision remains unchanged, or that one actually recognizes what the other describes. I know of no way of learning except by many and frequent appli-



**FIG. 1.—Cystoscope. A simple tube with its obturator. A large caliber instrument has been drawn for clearness of illustration. Exact size. (After Kelly.)**





**FIG. 2.—Showing easiest method of obtaining the lithotomy position for cystoscopic work without anesthesia. Although relatively uncomfortable it is equally as efficacious as the much less comfortable posture often portrayed with the hips bolstered on pillows and the patient much doubled up. Such a flexing of the trunk interferes with the upward movement of the abdominal contents and so lessens the freedom of distension of the bladder. It will be observed that the patient is raised to a very acute angle and is yet given a sense of perfect security by the sheet which can be seen passing about her shoulders. This posture can be easily maintained for a sufficient time for all ordinary cystoscopic manipulations.**



**FIG. 3.—Exaggerated Sims posture.** Even with the patient covered as in the actual work the increased angle with the horizontal of a line drawn from the sacrum through the vulvar cleft can be readily appreciated. Much greater freedom of the bladder from intra-abdominal pressure is thus gained. A sand-bag covered with many thicknesses of folded sheet is placed between the left hip and the table, thus raising the hips six or more inches above their position in the ordinary Sims posture, while the position of the knees, abdomen and shoulders remains unchanged. Compare with Fig. 4.



**FIG. 4.—Ordinary Sims posture. Note the absence of elevation of the hips and the consequent less angle of the vulvar cleft, thus permitting much greater intra-abdominal pressure than in the exaggerated posture shown in Fig. 3.**



**FIG. 5**—Genupectoral posture. The patient covered as in actual work. Compare with Fig. 6.



**FIG. 6.—Genupectoral posture showing the necessary details, namely, the vertical thighs with knees separated and the feet projecting just beyond the edge of the table. It should be possible to pass the hand between the separated thighs and between the fronts of the thighs and the abdominal wall which should not be allowed to remain in contact with the thighs at any point. Such contact can be corrected by carrying the shoulders forward and away from the knees.**

cations of the technic in coöperation with a good diagnostician. It cannot be learned in a dozen clinics by any means. Oftentimes old and indolent, but none the less troublesome, ulcers can only be recognized by the appreciation of a local difference in the lustre or color of the bladder lining. The variations in color are often very slight, the ulcer being of a very slightly yellowish tinge with, oftentimes, only a faint suspicion of a red demarcation at its edge. One patient in whom three such ulcers existed came under my care with an interesting history in this connection, well illustrating the difference between modern and older methods of treatment:

CASE II. S. 4., No. 51: Aged 50 years. Married. She has had seven children, the youngest 19, oldest 27 years of age. The relevant history is that after the birth of her youngest child she was infected by a catheter, resulting in a tedious acute cystitis which ran into a chronic form. During eleven years she was treated almost constantly for this chronic cystitis; she was given many and various prescriptions, and was sent to springs and water-cures at home and abroad. She usually received temporary benefit from each new treatment. Eight years before her illness became known to me (December, 1900) she resorted to a professor of gynecology in one of our leading medical colleges, who on hearing her history prescribed a simple remedy and told her to take only simple remedies when needed, to live a quiet, easy life and to "make up her mind to have bladder trouble as long as she lived." This advice was honest and was followed for eight years with results as good as those of the previous eleven. In 1900 her son, a medical student, who knew my enthusiasm for cystoscopic work prevailed upon her to make one more attempt to get well. A cystoscopic examination revealed three small, indolent ulcers near the ureteral orifices and trigonum, but not upon either of these structures. A bead of silver nitrate was fused upon a probe and each ulcer lightly touched. Another such treatment was applied at the end of five days, when the first sloughs had nearly separated; afterward there were four applications of 10 per cent. silver nitrate solution, whereupon the patient was discharged cured. She remains well to my certain knowledge at the present writing, five and one-half years after a treatment of only six visits. Nor is this case unique.

Permit me now to give a brief description of the technic. Boil all instruments and materials to be used, wrapped up in a large towel. While they are boiling wash the hands as for an obstetric case. When the instruments have been brought to the boiling point, not merely laid in hot water, for ten minutes in a one per cent. soda solution, remove the instruments to a table or chair, and so spread out the towel in which they have boiled as to constitute a sterile surface upon which they may lie.

Having the patient in the exaggerated Sims posture, preferably upon a dining or kitchen table, take absorbent cotton just boiled in a pair of sterile long uterine or dressing forceps and thoroughly scrub the vulva and especially about the meatus with a 1 to 3000 corrosive solution. Next, with the sterile forceps place a few crystals of cocain just upon and within the external meatus. Any injection of cocain solution into the urethra or the bladder is to be avoided, as it is entirely unnecessary. The external meatus is the only sensitive point. Allow the cocain three minutes in which to obtund sensation, during which time again wash up, as the hands have probably become contaminated.

At the end of three minutes, having the labia separated for you by a nurse or assistant, catheterize, and insert the calibrator up to the point two millimeters beyond the size of the cystoscope intended for use. The number ten (ten millimeters in diameter), is the most generally useful size. Hold at the maximum dilatation for ten to fifteen seconds, after which remove it and quickly insert the cystoscope (Figs. 7 and 8).

All four quadrants of the bladder should be systematically inspected. Great aid will be given in inspecting the posterior bladder wall, the trigonum, and the ureteral orifices, if a Sims speculum is introduced into the vagina—which becoming thus distended forces the vesico-vaginal septum forward into easier access.

Diseased areas of small size, such as ulcers, are best treated by silver nitrate, either in solutions of varying strength, the mitigated stick, or by the pure crystals fused into a bead upon the end of a probe. Diffuse inflammation is best treated, in severe cases, by means of Clark's balloon with ichthyol, protargol, or corrosive solution, and in milder cases by lavage.

Time does not permit a detailed account of the treatment of



**FIG. 7.—Cystoscopy with patient in exaggerated Sims posture.**





**FIG. 8.—Cystoscopy with the patient in the genupectoral posture.**

individual lesions, nor the discussion of those cases requiring curettage of ulcerating surfaces, the removal of growths, and many other phases of the question. Nor does it admit of the consideration at this time of tuberculous cystitis, which deserves as much time in itself as I have given to the subject in general. Nor can I speak of the very interesting work being done in ureteral and renal diagnosis and therapy through the cystoscope. In this latter connection, however, I wish to say that in cases in which a diagnosis of cystitis has been made, in which no attempt is to be made to pass an instrument which must be so touched by the hand as to contaminate the portion entering the bladder, or passing through the bladder into the ureter, such careful sterilization of the hands, as above outlined, becomes unnecessary, so long as a sufficient familiarity with the technic has been acquired as to avoid bladder or ureteral infection.

Always conclude every cystoscopic manipulation by catheterization, with the patient in the ordinary dorsal position, to remove the distending air from the bladder, since unless thus removed it causes pain, often severe in type and sometimes lasting for several hours. Patients have often been frightened away from continued cystoscopic treatment by neglect of this precaution at their first treatment.

I wish to say just a word about washing the bladder. In those cases in which the cystoscope reveals a general hyperemic condition, in the total absence of actual ulceration, or in which such hyperemia persists after the healing of an ulcer, and in those cases of hyperemia of the trigonum which have not yielded to medicinal treatment, a cure can usually be most promptly accomplished by lavage. I am convinced that washing with boric acid solutions, although advocated in standard and authoritative text-books for many generations, is no better than washing with plain sterile water. It is not sufficiently active.

For this class of cases I wish to add my mite to those who advocate the use of potassium permanganate solution. It has many advantages. But do not do as I did. Once, following the advice of a noted author, I used a one per cent. solution. The pain was so severe as nearly to distract the patient who went home from the hospital and was sick in bed for a week, during which time I

was threatened with a malpractice suit. The suit fell through, however, because at the end of ten days the patient found herself entirely cured of a most distressing and obstinate case of hyperemia of the trigonum. I have since used even stronger solutions, but always under anesthesia, and with the understanding that it is severe treatment, with confinement to bed and opiates when needed during the first few days. I ordinarily employ a 1 to 2000 solution as a beginning; this can rapidly be increased in strength up to the point of tolerance for the given patient.

Its advantages are that in fresh solution it is an active germicide. It rapidly oxidizes all dead organic matter, and in so doing the solution becomes decolorized. Therefore, by contrasting the color of the solution as it is returned from the bladder with its color originally one can readily and accurately tell when the bladder has been sufficiently washed. It is an astringent—which is an important item in these cases of hyperemia. The technic is known to you all. A little solution should be left in the bladder, so that the patient can void it through the urethra.

In conclusion I wish to note a few generalizations, some of which are the result of my own observations:

I have often noticed that cystitis is much more unfavorably influenced by a chilling or dampening of the lower extremities than by a similar, or worse, chilling of the upper portions of the body; the patients who do not require strict confinement to bed or the house, therefore, should be particularly cautioned in this respect.

The regulation of the general hygiene, diet, rest, and exercise require no special consideration here, because I fully realize that you appreciate their paramount importance in relation to the predisposing causes of chronic cystitis. Of course, no treatment will cure cystitis dependent upon tuberculosis, nephrolithiasis, abscess, or other disease of the upper urinary tract until such cause has been removed or has received its own appropriate treatment.

# Laryngology

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## THE LARYNGEAL COMPLICATIONS OF PULMONARY TUBERCULOSIS

A CLINICAL LECTURE DELIVERED AT THE ARMLEY HOSPITAL FOR CONSUMPTIVES,  
LEEDS, ENGLAND

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GENTLEMEN: If it falls to one's lot to see much pulmonary tuberculosis, one is soon struck by the frequency of the laryngeal complications of this disease and their importance from the standpoint of diagnosis, prognosis, and even treatment. Much of what I shall have to say will be based on 100 cases in which these laryngeal complications of tuberculosis were present. The following are short details of the eight cases which you have just seen, and which are at present or have recently been in the Hospital.

CASE I.—James H., aged 25 years. Cough for four or five years. Hoarseness for a little over a year. Extensive disease in the left lung with excavation at the apex. Laryngeal catarrh without infiltration.

CASE II.—Robert W., aged 21 years. Cough for two and a quarter years. Hoarseness for twenty months. Disease chiefly at the left apex, but it is extending rapidly. Fever. Diarrhea. Both cords are thickened and infiltrated.

CASE III.—Ernest M., aged 28 years. Cough for three or four years. Hoarseness for thirteen months. Extensive disease of the left lung. Fever. Infiltration of both cords, especially the left, and swelling in the inter-arytenoid region.

CASE IV.—Lewis F., aged 34 years. Cough for fifteen

months. Hoarseness for about three months. Extensive bilateral disease, more marked on the left side. No fever. Infiltration and ulceration of the hinder part of the left cord, which is healing.

CASE V.—Henry W., aged 29 years. Cough three and a half years. Hoarseness for fourteen months. Extensive bilateral disease. Fever. Considerable infiltration of the posterior part of the larynx. No pain in swallowing.

CASE VI.—Fred C., aged 33 years. Cough for four years. Hoarseness. Extensive bilateral disease, especially marked on left side. Infiltration of the left cord and left aryteno-epiglottic fold. Infiltration and ulceration of the left edge of epiglottis. No pain in swallowing. The laryngeal disease has developed under observation.

CASE VII.—John H., aged 39 years. Cough for one year. Hoarseness variable. Bilateral disease, but the signs are slight. Fever. Epiglottis erect, rigid, infiltrated and covered with small ulcers. Only moderate difficulty in swallowing.

CASE VIII.—John J., aged 33 years. Cough for three years. Extensive bilateral disease, especially on the left side. Laryngeal disease discovered accidentally, but occasional hoarseness now. Left cord fixed. Larynx otherwise quite healthy. No enlarged glands in the neck.

When we consider the position and configuration of the larynx, its liability to strain and even traumatism, and its exposure to bacteria-laden sputum, there can be no surprise that laryngeal complications occur in pulmonary tuberculosis, but only wonder that they are not much more frequent than they actually are. The frequency of tuberculous laryngitis alone is variously given at from 20 to 50 per cent. It is more common in men than in women. It may occur at any stage in pulmonary tuberculosis, but is more common in the advanced disease. Unhealthy states of the naso-pharynx have been assigned by some as a predisposing cause of tuberculous laryngitis in phthisis. I have certainly seen such cases (Case IV), but I have also seen cases of naso-pharyngitis in phthisical patients who have not developed tuberculous laryngitis.

If the larynx is, on the one hand, peculiarly exposed to the tuberculous infection, it has also, on the other, important defensive mechanisms. The in-coming air arrives in a warm and more or less filtered state. The possession of a ciliated epithelium by the great-

est part of its surface and the presence of numerous mucous glands, as well as its reflex irritability against foreign particles, are undoubtedly important factors in producing what immunity it possesses against infection. The extraordinary rarity of primary laryngeal tuberculosis may be attributed to this power of defence. The larynx is rarely infected through dust and bacillus-laden air, but by the bacilli in the sputum which may penetrate through erosions and defects in the epithelium or through the interstices between these cells, or, as Horne maintains, by way of the ducts of the mucous glands. This sputogenous infection of the larynx is much more common than any infection through the agency of blood-vessels or lymphatics, except perhaps in the rare form of miliary tuberculosis of the larynx. Such reasons as were advanced in favor of a hematogenous or lymphogenous infection are no longer tenable. Frese has recently produced in a dog a tuberculous laryngitis by rubbing into the laryngeal mucous membrane virulent tuberculous sputum, and there bacilli were found beneath an intact epithelium.

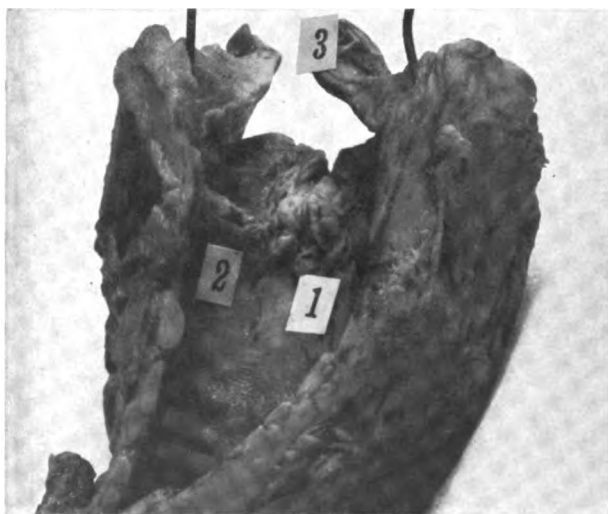
Granted the frequency and importance of the laryngeal complications of phthisis, the necessity of the inspection of the larynx in the routine examination of every case of phthisis becomes evident. Even when there is no very obvious lesion present in the larynx, it is not at all uncommon to find its walls bathed in sputum, especially posteriorly. In carrying out this systematic examination I have not found marked pallor of the mucous membrane present as often as might have been expected, yet its importance when present, and especially if localized, is undoubted. The cords frequently present a flabby appearance, with perhaps a slight injection, especially along their free margins, the changes not being marked enough to be classed as a laryngitis. Some have emphasized the importance of slight paresis of the cords in early phthisis. I have sometimes seen such paresis of unexplained origin, but unfortunately I have not followed it up.

The well-known laryngeal catarrh of the tuberculous is characterized by its obstinacy—so much so that when a laryngeal catarrh, occurring especially in a young subject and of unknown causation, resists the ordinary methods of treatment, it is strongly suggestive of pulmonary tuberculosis. There may be some difficulty in distinguishing this catarrh from the earliest stage of laryngeal phthisis.

There is nothing in the above-named changes in the larynx which can be stated to be really tuberculous in nature, although often associated with phthisis. The actual invasion of the larynx by the tubercle bacilli is usually said to produce first the catarrhal stage of tuberculous laryngitis, which may further pass into the stages of infiltration and ulceration, including perichondritis. The last-named process results from a deep extension of the ulceration, and is rarely if ever primary. Both the stages of infiltration and ulceration are often accompanied by some edema (said by some to be due to a secondary infection) and this, along with the pallor, gives to the tuberculous lesions their characteristic appearance. The distinction between the laryngeal catarrh of the tuberculous and the catarrhal stage of tuberculous laryngitis lies chiefly in the more uniform distribution and absence of infiltration in the former. In the latter the catarrh is curiously localized. One cord alone is affected, or only its hinder part, or perhaps its anterior portion. Horne explains the escape of the middle part of the cord as being due to the absence of glands from it. Sometimes, as in a case at present under my care, there may be in addition a striking pallor of some other part of the larynx. A careful examination with a good light (and personally I prefer the lime-light) is clearly necessary.

Infiltration, which represents the second stage of the disease, has certain sites of predilection to be classed in their order of frequency as follows: the inter-arytenoid fold and the arytenoid regions, the vocal cords, the aryteno-epiglottic folds, the ventricular bands and the epiglottis. Infiltration may occasionally occur in the sub-glottic region, as in a case at present under observation in which the swelling is seen anteriorly beneath the cords.

Infiltration in the inter-arytenoid region is not quite characteristic of tuberculosis, unless it projects into the glottis in an irregular tongue-like fashion, when it most probably constitutes the upper limit of an ulcer. Swelling in this region is said by some to occur in atrophic pharyngitis. I do not recollect having seen a case which could be attributed to this cause, but I well remember making a diagnosis of tuberculous laryngitis in the case of a medical man who had an inter-arytenoid swelling, and who was anemic and debilitated. The subsequent course of the case showed the diagnosis to have been wrong. The inter-arytenoid region is, however, not often



**FIG. 1.—Pachyderma laryngis, with ulceration of the right cord. The larynx laid open from the front: 1. Situated just below the pachyderma which involves the posterior laryngeal wall. Great thickening of epithelium which is hard and of a dull yellowish-white color. Much wrinkling and crinkling of surface. 2. Placed below a clean-cut ulcer situated on the posterior extremity of the right cord. 3. Placed on the epiglottis which has been cut through. From a man aged 35, with pulmonary phthisis but with no noteworthy laryngeal symptoms. Death due to cirrhosis of liver.**





the seat of pathologic processes other than tuberculosis. The color may assist in the diagnosis, yet I know of another case of well-marked phthisis in which the inter-arytenoid infiltration was of a much brighter red color than usual. Pachyderma of the larynx is sometimes seen in this region. I have a specimen (Fig. 1) showing also an ulcer on the cord. It was taken from a patient with chronic phthisis without obvious laryngeal symptoms, who died of cirrhosis of the liver. Schnitzler looked upon such a pachyderma as representing a very chronic tuberculosis which ultimately breaks down. Horne, on the other hand, thinks that it may represent a healing of the disease. Infiltration may occur in the arytenoid region, where it forms a globular swelling. Recently I saw a case of the kind which gave rise to considerable difficulty in diagnosis. The hoarseness, somewhat intermittent in character, had extended over several years. The swelling looked unusually dense. In the chest there were signs of bronchitis, but none distinctly of phthisis. The diagnosis must in this case remain in suspense until a thorough investigation of the case has been made. When the cord is infiltrated the free edge loses its sharp outline and appears round. Sometimes the infiltration takes place in the upper and lower lamellæ of the cord, and so gives it a split appearance. The infiltration may, as has been said, be quite localized, as in Case IV (at present under treatment) in which the posterior part of the left cord about the process is alone involved. Infiltration and over-growth of tissue may attain to such a degree as to warrant the name of polypoid tuberculous laryngitis. Thus, in a case at present under observation with well-marked signs, chiefly basic, of phthisis, at least two relatively large polypoidal masses have been removed from the infiltrated right cord. The left cord is infiltrated with rounded edges and looks split. Definite tuberculous tumors of the larynx have also been described. The maximum amount of swelling is seen in the aryteno-epiglottic folds and epiglottis (lingual aspect) owing to an abundant submucosa. The swelling of the former, which may be unilateral or bilateral, is of pyriform shape, and that of the latter helps to produce the so-called turban appearance. Sometimes the infiltrated epiglottis stands up erect and rigid-looking (Case VII), and subsequent ulceration may produce deformity or even destroy it altogether. The ventricular bands may attain a considerable size, one or both

being involved in a dense swelling which may hide the corresponding cord. In a case (XI) to be subsequently referred to, this swelling was the chief cause of laryngeal obstruction, necessitating tracheotomy. Special attention has been called recently to a sub-glottic swelling just below the anterior insertion of the cords, as some glands lying on the crico-thyroid membrane have been found enlarged and tuberculous, secondary to the intra-laryngeal lesion. Sub-glottic swelling may give rise to stridor and even stenosis.

Ulceration, superficial or deep, may appear in the infiltrated tissues. The superficial ulcers are mostly small, lenticulate in shape, often with sharp margins, or they may present a worm-eaten appearance. They are seen in most characteristic form in the infiltrated aryteno-epiglottic folds, on the under-surface and edge of the epiglottis, also in the sub-glottic region and in the trachea between the rings. There are two ulcers which I would more especially draw attention to, namely, those on the cords and those on the inter-arytenoid fold. The ulcer on the cord is most frequently on its hinder part in the infiltration described above. It may produce considerable destruction of the cord here. Another ulcer appears to split the cord longitudinally so that it looks double. Sometimes the edge of the cord is saw-like from ulceration. The inter-arytenoid ulceration often leads deeply down to the bare arytenoid cartilage. In some specimens a relatively huge ulcer occupies this region and has destroyed the posterior part of the cord. In the bottom of this ulcer the necrosed arytenoid cartilage may be seen. The effect of this ulceration may thus be a perichondritis and the cartilage may be exfoliated, as in Case IX, subsequently to be referred to. This perichondritis may lead to fixation of one or both cords. If both cords are fixed in a position of adduction considerable stenosis, necessitating tracheotomy, may occur, as in a case recently under my observation. A cord may be fixed from causes other than perichondritis. Thus in Case VIII with advanced phthisis, the left cord is motionless. The larynx otherwise looks quite normal and the cord is quite white. I have notes of four other cases of a motionless left cord, and in three of these there was no reason to think that it was a mechanical fixation. In two of the three there were enlarged glands in the neck.

Before leaving the subject of fixed and paralyzed cords I might

refer to a case of bilateral phthisis in one of our institutions, in which there is hoarseness of varying degree, and in which the only defect to be seen in the larynx is a deficient approximation of the cords in phonation due to paresis of the thyro-arytenoid muscles.

The lesions found in the larynx in phthisis may be divided into two classes: those which affect more distinctly the interior of the larynx (internal tuberculous laryngitis), and those which involve the entrance to the larynx (upper tuberculous laryngitis). Sometimes both varieties exist together and a diffuse tuberculous laryngitis of most unfavorable prognosis results. Fortunately the disease is more often of quite limited distribution, but it may spread. I have occasionally watched infiltration follow upon the catarrhal stage of the disease, and I have seen an inter-arytenoid infiltration spread and involve the posterior part of a cord. In Case VI the disease has passed through the catarrhal stage to the stages of infiltration and ulceration while it has been under observation.

There may occasionally be a difficulty in distinguishing tuberculosis of the larynx from syphilis. I particularly remember one case, in a man aged 35, in which I made the diagnosis of stenosis of the larynx due to tuberculosis. The case turned out to be syphilis and recovery followed laryngotomy and appropriate treatment. It is maintained by some that syphilis and tuberculosis may co-exist in the larynx. The particular site of the lesion, the color of the infiltration, the usually rapid development of the disease in syphilis without a corresponding impairment of the patient's health, as well as the deep ulceration with consequent deformity (including stenosis), are important points in the differential diagnosis. Syphilitic manifestations in the larynx are usually quite amenable to treatment. Careful examination of the chest and sputum, the temperature-record, etc., are also of much importance.

The *symptoms* directly produced by the laryngeal lesions are relatively few in number. The voice may or may not be affected, according to the situation of the lesion. If the disease is situated inside the larynx the voice will most often be affected, but if the disease is of the upper variety the voice may entirely escape. Alteration in the cords themselves will give rise to hoarseness. Any lesion which mechanically interferes with the due approximation of the cords will, of course, affect the voice. If a cord is paralyzed,

as in Case VIII, the other cord may swing across and a voice altered only in timbre may result. Occasional hoarseness may sometimes exist, as in this case, and the cough be imperfect. There is nothing really characteristic in the voice of the patient with laryngeal phthisis except its weakness, due to the insufficient blast of air and debility of the laryngeal muscles. However, the toneless voice with much breathiness is more frequently met with in laryngeal phthisis than in other affections of the larynx. Spontaneous pain may be present in the larynx radiating into the ear, but it is not usually a prominent feature. There may be a sensation of tickling in the larynx which may cause cough. Local external tenderness is not common, and is mostly due to perichondritis. Pain on swallowing is usually present when the parts about the entrance into the larynx are affected, and especially the epiglottis, but sometimes, as in Case VI, the epiglottis and corresponding fold may be involved and yet there be no pain on swallowing. On the other hand, the pain may be so severe as to cause the greatest distress. Even the movements of the larynx and the friction of the parts may cause pain. Swallowing of saliva may be more painful than that of food, so that the day's expectoration may be considerable.

Obstruction to respiration, including stenosis, is not very common, but may occur. Edema itself rarely gives rise to it. In some cases all symptoms directly referable to the larynx may be absent and the disease be discovered only on the routine inspection of the larynx, which should never be omitted.

#### LARYNGEAL COMPLICATIONS AND THE DIAGNOSIS OF PHTHISIS

In cases in which the signs in the chest are equivocal, the recognition of the nature of the laryngeal lesion may determine the diagnosis. It is possible that in some cases in which there are no reliable signs in the chest and no obvious laryngeal symptoms, the examination of the larynx may reveal the presence of a tuberculous lesion or show changes, such as circumscribed pallor, etc., not infrequently associated with tuberculosis of the lungs. Clinically it may sometimes appear that the laryngeal disease is primary, but here the clinical evidence is not reliable, just in the same way that the clinical examination of the chest at times leaves one in doubt as to the existence of uncomplicated phthisis, when an examination of the

sputum or even the tuberculin test reveals the presence of the disease. So rare is primary laryngeal tuberculosis that it may be taken for granted that pulmonary disease always co-exists.

It is very generally admitted that the presence of laryngeal phthisis masks the ordinary signs of pulmonary phthisis. There are undoubtedly cases of laryngeal phthisis in which the signs are very slight or even equivocal. On the other hand, one often sees cases of laryngeal phthisis in which the physical signs are extremely extensive (Cases IV, V, VI, VIII, X). I have also had cases of phthisis under observation with extensive disease, such, for instance, as Case VI, and in which laryngeal complications have supervened and yet the signs remained as obvious as before. Cases of laryngeal obstruction must be excepted, yet even here the physical signs may be obvious, as in Case XII to be subsequently referred to. An explanation of this so-called masking of the physical signs may be due in some cases to more disseminated disease instead of the more massive tuberculosis of the lung usually met with. Not very infrequently cases of ordinary phthisis are seen in which the general symptoms indicate a severe infection, and yet the physical signs of disease in the chest are quite trifling, as in a case at present in our Sanatorium at Gateforth. Apart from laryngeal obstruction it is not obvious why the signs should be masked beyond the fact that the cough may be toneless. It seems to me more probable that the same diminished resistance of the individual which leads to the early appearance of laryngeal phthisis has also led to a more disseminated lesion in the lungs. It has been said that tubercle bacilli are even more generally found in laryngeal phthisis than in the uncomplicated disease, but this does not altogether accord with my experience.

#### LARYNGEAL COMPLICATIONS AND THE COURSE OF PULMONARY PHTHISIS

I purpose to discuss here the mutual behavior of the laryngeal and pulmonary disease as well as the prognosis of tuberculous laryngitis.

Obviously the prognosis of laryngeal phthisis is that of ordinary phthisis with the addition of a further undoubtedly unfavorable element, namely, another localization of tuberculosis, and that in the air passages. For the great majority of cases it must still be ad-

mitted that the prognosis of laryngeal phthisis is very unfavorable. As has been well said by Bosworth, the nearer the tuberculous lesion in the respiratory tract approaches the outside world, the greater its virulence, though its frequency is less. So bad is the prognosis that the question has been raised as to whether laryngeal phthisis is really curable. It is undisputed that tuberculous ulcers may heal, but it must surely be of the rarest occurrence that extensive laryngeal infiltration and ulceration will really heal. By healing is understood that the tuberculous lesions are replaced by scar tissue and softened areas impregnated with lime salts. Tuberculous lesions appear to show less tendency to heal in the larynx than elsewhere. I have not had the good fortune to see a single pathologic specimen of a really healed laryngeal tuberculosis. If healing is to take place it must occur early in the disease. This healing in the earlier disease is believed by many authorities to occur even in the absence of local treatment. The following are the only cases in my series which bear on this subject (Fig. 2):

CASE IX.—Mr. T., aged 29 years, who had been treated in a sanatorium for consumption, showed an injected right cord and a definite swelling in the inter-arytenoid region. He has coughed up several hard masses believed to be cartilage (a specimen shown). When he was last seen all infiltration had disappeared. He had been carrying on the sanatorium treatment in the country and had given his voice practically complete rest. As he appeared to be in every way quite well, he was allowed to start for South Africa.

CASE X.—Mr. X., aged 40 years, with bilateral and extensive disease, has been on and off under my observation for six or seven years. During this time he has had two very severe hemoptyses. Three years ago, while in a sanatorium, laryngeal symptoms appeared. There was an inter-arytenoid infiltration and a marked projection into the glottis. When I last saw him (May, 1905) this had almost disappeared. No local treatment was adopted. He was under treatment last year for an abscess, undoubtedly tuberculous, about his shoulder.

The next case is one in which healing cannot be said to have occurred, but the disease, both laryngeal and pulmonary, appears to be arrested.

CASE XI.—Albert D., aged 32 years, came under observation

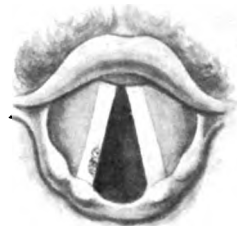
### CASE IX



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### CASE X



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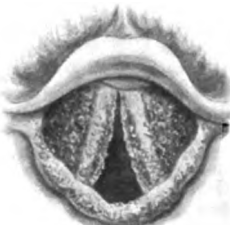


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### CASE XI



1



2



3

### CASE XII



FIG. 2.—The appearance of the larynx in several cases of laryngeal tuberculosis. Case IX. Laryngeal disease healing; early pulmonary disease. (1) May 21, 1903; (2) July 23, 1903; (3) April 11 and November 17, 1904. Case X. Laryngeal disease healing; advanced bilateral pulmonary disease. (1) July 21, 1903; (2) October 21, 1903; (3) October 10, 1904 and May 27, 1905. Case XI. Tuberculous laryngeal stenosis; tracheotomy (November 30, 1902); disease stationary. (1) July 23, 1902; (2) April 1, 1903; (3) April 4, 1906. Case XII. The patient is reported as being quite well; lactic acid treatment. Condition on January 6, 1908, is illustrated.





in July, 1902, with progressive tuberculous laryngitis. There was at first considerable swelling of the left aryteno-epiglottic fold and inter-arytenoid region. Subsequently the ventricular bands became enormously infiltrated so as almost to meet in the middle line. Tracheotomy had to be performed on November 30, 1902, and for the last three years his condition has been fairly stationary. He still wears the tube, but he can speak with a deep, rather loud and rasping voice. He has recently been in the Leeds Infirmary with an abscess.

CASE XII.—Mrs. C., aged 42 years, had a distinct infiltration in the inter-arytenoid region, and slight but reliable signs of phthisis at the left apex when seen in October, 1902. Lactic acid was vigorously rubbed in on six occasions, the pure acid being eventually employed. The last application was followed by severe spasm and she was ill for some little time after it. She then improved, and is now reported by her medical attendant to be quite well.

In cases of early laryngeal tuberculosis with pulmonary phthisis, the prognosis is made in the usual way. A careful study is made of the extent of the lung disease and of the symptoms which it gives rise to. For this purpose patients admitted under my care remain in bed for the first week so that they may be the better observed. At the end of this time a short summary of the case should be made, and the prognosis formed. The presence of fever or unstable temperature, of rapid or unstable pulse, of anemia or of great wasting (unless due to insufficient food), or of complications, etc., are unfavorable elements in the prognosis. In alcoholics, I believe, an unfavorable prognosis is always warranted.

Thus, the main objects in view are first to ascertain the extent of the disease and then (what is a much more difficult matter) the resistance of the individual.

It seems to me that the problem of the prognosis so far as the larynx is concerned may be stated as follows:—

The prognosis of extensive laryngeal tuberculosis, especially of the upper variety, is hopeless so far as life is concerned, though much may be done by way of palliation. The prognosis of limited tuberculous laryngitis of the upper variety is most unfavorable. I am, of course, aware that some authors have reported recovery when the disease has affected the epiglottis.

Limited laryngeal tuberculosis, especially when affecting the vocal cords, ventricular bands or the inter-arytenoid region, offers a chance of recovery, provided always that the pulmonary lesion is also limited, and this chance, it appears to me, may be increased by judicious local treatment. In the prognosis of laryngeal phthisis it must be remembered that the laryngeal lesion is more often met with in advanced phthisis. Laryngeal catarrh, unless it leads to a subsequent tuberculous infection, should not influence the prognosis unfavorably, yet they are not satisfactory cases in my experience. Paralysis of a cord of extrinsic origin probably has little effect upon the course of the phthisis.

There seems to be almost a hopeless difference of opinion as regards the mutual behavior of the laryngeal and pulmonary lesions. Many maintain that there is no parallelism in their respective courses, namely, that the laryngeal disease may improve while the pulmonary disease is advancing, and *vice versa*. Some laryngologists thus hold that the prognosis depends almost exclusively upon the condition of the lungs. Perhaps it is more correct to say that it is the diminished resistance of the individual against the infection, as shown by the multiple localizations, which really destroys life rather than the mere intensity of the pulmonary disease. At any rate the laryngeal disease often tends directly to shorten life. The majority of cases of phthisis with laryngeal tuberculosis succumb within eighteen months of the onset of the laryngeal symptoms. Case XI has certainly already lived forty months, and the course of the two lesions of recent times appears to have been parallel. In Cases IX and X the pulmonary and laryngeal disease kept pace with one another in the improvement, but in Case XII the extensive pulmonary disease was perhaps stationary when the laryngeal disease was improving. There is no doubt that the pulmonary disease acts detrimentally on the laryngeal disease by the cough which deprives the larynx of necessary rest, by the secretion which has to be expelled through the larynx, and by the possible re-infection of the larynx. An interesting case has been recently recorded by Griffin in which the laryngeal disease broke out again on three separate occasions during the progress of four or five years. The laryngeal disease also influences unfavorably the pulmonary disease by the irritative and perhaps sometimes ineffective cough which

results from its involvement, by the possible aspiration of tuberculous material from its lesions and especially in some cases by the distressing pain which among other things interferes with the feeding of the patient, and so favors the further extension of the lung disease.

#### MANAGEMENT OF LARYNGEAL PHTHISIS

In the prevention of the development of laryngeal phthisis all irritation of the laryngeal mucous membrane must be avoided, such as dusty atmospheres, smoking (if it in the least irritates), excessive use of the voice, ineffective cough, needless scraping of the throat. Notwithstanding all precautions, laryngeal complications will sometimes develop under the best hygienic conditions, such as in sanatoria in specially selected localities (Cases XII, VI).

The general treatment of the case is the same as in ordinary phthisis. There has been much discussion about high and other altitudes in the treatment of laryngeal phthisis. Possibly, as Latham suggests, a dry and bracing climate suits the earlier, and the more humid climate the later stages of the disease.

Rest to the voice is essential, at any rate in cases in which there is reason to hope for healing. It may be desirable even to insist on the use of a slate and pencil. The laryngeal catarrh of the tuberculous requires careful treatment. This catarrh may very probably pave the way for the tuberculous infection. Rest to the voice, including whispering and throwing the voice forward in speaking, and the control of ineffective cough are important. Moist inhalations may be of value. I have often used formalin (1 dram to 1 ounce of water) in the reservoir of a steam spray apparatus. The inhalation must not irritate. Sprays, especially the cleansing alkaline spray with carbolic acid (4 grains to 1 ounce) are more useful. A patient should be taught to use the spray properly, so that it penetrates into the larynx. In irritative states of the larynx a spray of menthol in oil (10 grains and more to the ounce) may be useful. Personally I am not much inclined to swab out the larynx with astringent paints on the least provocation.

In the catarrhal stage of tuberculous laryngitis much the same treatment may be employed. A spray of formaldehyde (1 to 3 minims to the ounce) is strongly recommended by some.

In the stage of infiltration, cleansing the larynx and rest are

again important. If the cords or inter-arytenoid region are involved, a whispering voice should be adopted and as little as possible of that. Applications of lactic acid by the swab or brush have been recommended, but it is difficult to see how the acid can penetrate intact infiltrations, and the treatment may be trying to the patient. Scarification, incisions, punching out portions of the infiltrated tissues have been recommended, but I shall return to this subject later. Menthol injections (20 per cent.) may be used.

*Stage of Ulceration.* Here undoubtedly the lactic acid treatment is suitable, especially if the disease in the larynx is limited. At least a partial anesthesia with cocain should precede the application. With the help of the laryngeal mirror and a swab the lactic acid is firmly rubbed into the diseased part. Before applying the acid, the superfluous fluid is shaken off lest it drop into the trachea and cause spasm. Painting out the nose with cocain is said sometimes to prevent spasm in those likely to have it. The lactic acid is used in strengths from 25 to 80 per cent., or even pure. I have used Lake's pigment, diluted if necessary. The application may be followed by an insufflation of orthoform. In the inter-arytenoid region it is quite a proper procedure to lop off with the laryngeal punch the protruding granulation tissue and to use the curette to the ulcer. The larynx must be thoroughly anesthetized. After curetting, lactic acid is rubbed in and then orthoform insufflated. An obstinate ulcer on the cord or elsewhere may be curetted. The ventricular band is the only locality from which troublesome bleeding has been known to occur. Equal parts of lactic acid (80 per cent.) and liq. ferri perchlor. is recommended by Lake and Barwell in severe bleeding. Although one may not be inclined to follow these authors in all their recommendations as to the operative treatment of laryngeal phthisis, yet their book contains many useful details of treatment. In more recent times much more active treatment by the punch and curette have been recommended, chiefly by Lake, and good results have been recorded. On the whole, the majority of those called upon to treat laryngeal phthisis prefer, at any rate at present, not to break into intact infiltrations. These infiltrations may persist for long enough without breaking down (Case XI). Indications for the more radical treatment have been laid down as follows: (1) Where the laryngeal disease is primary; (2) where the lung disease is slight;

(3) where there is circumscribed ulceration and infiltration; (4) where there is a dense swelling in the arytenoid region; and (5) where there is advanced pulmonary disease with distressing dysphagia.

I have no experience of the use of the galvano-cautery or of submucous injections in laryngeal phthisis.

Of other methods, tracheotomy has found vigorous advocates and equally vigorous antagonists. In Case XI, I think it cannot be denied that tracheotomy has largely contributed to an arrest of the laryngeal disease in addition to meeting the *indicatio vitalis*. Apart from the latter, Schmidt recommends tracheotomy under the following conditions: (1) Extensive laryngeal and slight pulmonary disease; (2) spreading laryngeal with not much pulmonary disease; and (3) difficult and painful swallowing. A somewhat facetious writer adds a fourth, namely, an absence of the necessary skill in intra-laryngeal manipulation on the part of the individual treating the case.

There are some obvious disadvantages in tracheotomy, and one of them consists in the increased danger of the spread of the disease to others. In one case I found tubercle bacilli in the sputum which was projected out of the tracheal opening and lay about the wound. Thyrotomy and laryngectomy are not to be recommended. I have seen one case of laryngectomy for tuberculous laryngitis performed some years ago by Mr. Edward Ward, of Leeds, at the urgent request of the patient. The operation itself was quite successful, but the patient soon succumbed to a foudroyant extension of his pulmonary disease.

In conclusion, something must be said about the palliative treatment of tuberculous laryngitis, especially when it affects the entrance into the larynx. Here anodyne powders, such as morphin and orthoform, if there is ulceration, are insufflated into the larynx before meals in painful swallowing. Orthoform insufflations may be carried out by the patient himself according to Leduc's method. A small portion of the powder is taken up into one end of a tube, 6 inches long and one quarter inch bore. The patient places the other end well back in his mouth and takes a deep inspiration. A 5 per cent. cocain spray may be used or the affected parts touched with cocain solution. Menthol in spray or pastilles ( $\frac{1}{4}$  grain) may be

of value. Some have recommended a teaspoonful of sweet oil of almonds to be swallowed immediately before food. Semi-solid food may produce least pain. The yolk of an egg is sometimes easily swallowed. Lake and Barwell recommended minced meat and the yolk of an egg in the German dish known as Biftik à la Tartare. Swallowing may be more easily effected in the prone position according to Wolfenden's method, or on the side with the foot of the bed raised as in Caselberry's method. Sometimes nasal feeding is necessary. Swallowing the semi-solid food in gulps may be successful.

In some cases in which the epiglottis is involved and the pain in swallowing is great, removal of the epiglottis by a special forceps (Mt. Vernon type) or by the galvano-cautery should be practised. Mr. Barwell kindly allowed me to see some of his patients in the Mount Vernon Hospital, London, and the relief obtained had been very considerable.

Finally, it seems to me that in determining the kind and degree of treatment to be adopted in tuberculous laryngitis, every case must be judged on its own merits. If the case offers reasonable hope of healing, then a more stringent and even more radical treatment may be proper, but it seems useless to treat actively patients in whom the pulmonary disease is advanced unless the laryngeal disease is causing real distress. Most of the cases of laryngeal phthisis which I see have advanced pulmonary disease, and I do not always find that disease of the epiglottis invariably produces distressing symptoms. It also appears to me that if any really active treatment is undertaken, the patient should be an inmate of an institution and under the best hygienic conditions.

# Otology

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## THE MASTOID OPERATION <sup>1</sup>

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It is with no small degree of misgiving that I come before the Section on Laryngology and Otology of the College of Physicians to present a paper upon a subject of which you are past masters, and of which so many of you have written so entertainingly and with so much erudition. In the time allotted me it will not be possible to go into all details with regard to the operation as done by me for acute mastoiditis, but simply to refer, by way of emphasis, to those features of the mastoid operation which I think are essential to make the operation complete and a thorough safeguard to the patient.

*The Preparation of the Patient.*—If sufficient time is permissible, all those preparations should be made which are required in all general major surgical operations—examinations of the blood, exudate, and the urine, should be made. The methods of preparation of the field of operation vary with us according to the age and sex of the patient. All male patients, and all female patients under the age of fourteen years of age, have the hair of the head removed entirely and the scalp shaved. This procedure makes the sterilization of the operation field more certain, the probable infection from the hair unlikely, and the presentation of hairs in or near the operative field during the course of the operation impossible, while the subsequent dressings are, from a tonsorial point of view, more comfortable and pleasant to the patient and physician. There can be no sentimental question raised as to the sacrifice of the

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<sup>1</sup> A paper read by invitation at a meeting of the Section on Laryngology and Otology of the College of Physicians of Philadelphia.



hair in the male and in female children, as is the case with the adult female. The hair has usually grown sufficiently to appear only as a close hair-cut by the time that the patient is ready to dispense with the bandages, and, as it comes out, when shaven, with absolute uniformity, it makes a better cosmetic effect than when it is removed only to the vertex on the operative side or only within a few inches from the operative field. In the adult female the hair is cut and shaven over an area about the ear, extending in a radius of three inches from the external meatus. The remain-

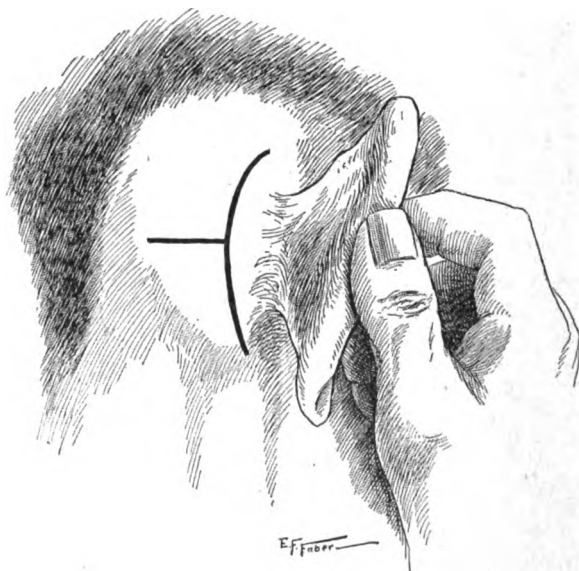


FIG. 1.—Line of incision through the soft parts.

ing hair is gathered up, and, at the time of the operation, is encompassed within a sterilized rubber hair-bag. The field of operation is prepared by scrubbing, as is done in ordinary surgical work. In this connection, I wish to call particular attention to the fact that thorough cleanliness can be obtained without using undue force in the application of the brush with resulting denudation of the epithelial surface of the skin. Violent cleansing is apt to be attended with infection of the skin from the bacterially laden exudation which issues from the diseased bone cavity. It is incumbent upon the operators to observe all the canons of modern aseptic

surgery and command a similar observance on the part of all assistants and nurses employed upon the case.

*The Character, Form, and Method of Management of the Incision Through the Soft Structure.*—The character of the incision which I employ is what is termed by Whiting the flap operation. An incision is made slightly curvilinear about one-quarter of an inch from, and parallel to, the attachment of the auricle to the side of the head, extending below from the extreme tip of the mastoid, just anterior to its center, and extending about one-half inch above the superior attachment of the auricle (Fig. 1). This incision should have made through the center of its posterior flap an incision directed horizontally backward, ranging in length from one to two inches, as the exigencies of the case may demand. This latter incision makes a wound with a single anterior flap and two posterior flaps. For several years in my work on the mastoid I have been questioning the advisability of adhering to the old single vertical incision through the soft structure in performing the operation, which feeling of indecision has caused me to break away from its tenets and do the flap operation whenever the induration of the tissue has been very pronounced or when the single incision has not given me sufficient space to operate with ease or comfort. The greater ease and comfort of operating, the more extensive exposure of the field of operation with assured safety thus vouchsafed, and the fact that the wound heals more kindly and that the extra cicatrix thus produced is entirely within the hair line, has caused me to adopt it latterly as the uniform incision to make in all acute mastoid work. These incisions should be made with the belly of the blade rather than with the point. In making the primary vertical incision, the knife should be made to cut directly to the bone with the one incision, except in cases of subperiosteal abscess, in which extreme caution should be employed. The periosteum should be cut through with as much care and precision as the integument. Unnecessary meddling on the part of assistants to check hemorrhage until the incision is thoroughly made down to the bone should be avoided. After the completion of the vertical incision, the horizontal incision extending from the center of the posterior flap is made. The periosteum is now elevated with extreme care from all directions and saved in its entirety to each flap. The anterior flap with its peri-

osteum is pushed forward until the posterior canal-wall is well shown with the meatal spine, while the posterior superior and posterior inferior flaps, with the periosteum, are stripped and folded back. The tip of the mastoid is then well exposed (Fig. 2). The separation of the tendinous attachment of the sternocleidomastoid muscle to the mastoid is best accomplished by the use of a director and a pair of blunt scissors curved on the flat. It is best to have the separation so complete that a finger can be readily passed around the tip and between it and the intervening soft tissue. All hemostats should now be removed and larger vessels which promise trouble should be ligated so as to have the operative field as free as possible from adventitious encumbrances. The anterior flap should be

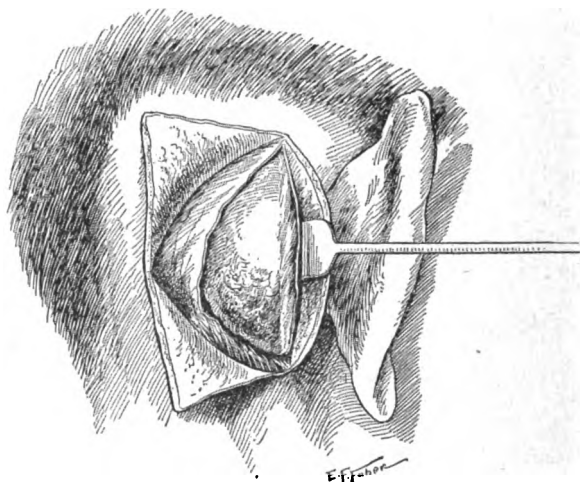


FIG. 2.—The flaps thrown back and the periosteum elevated.

drawn forward through the aid of a retractor given into trusty hands, with instructions that no undue pressure be made. The posterior flaps usually require no attention, but, should they show tendency to bend forward, they may be controlled by the same assistant who is retracting the anterior flap.

*The Character, Form, and Method of Management of the Opening of the Bone Cortex of the Mastoid.*—The character of the primary opening into the mastoid cortex is that of a shallow groove (Fig. 3), made parallel to and closely hugging the posterior canal-

wall, extending from within the suprameatal triangle opposite to the center of the suprameatal spine, to the tip of the mastoid apophysis. During the eight years contemporaneous with the institution and adoption of the uniform removal of the mastoid tip in all of my acute mastoid operations I have been resorting to the groove opening of the mastoid cortex instead of the classical funnel-shape mastoid opening. The groove is best made with the aid of a gouge chisel, the widest gouge being used that is consistent with safety in the type of mastoid being operated upon. In narrow mastoids, and when in doubt, it is better to use a narrow gouge and make several parallel grooves. The primary bone-groove, made through

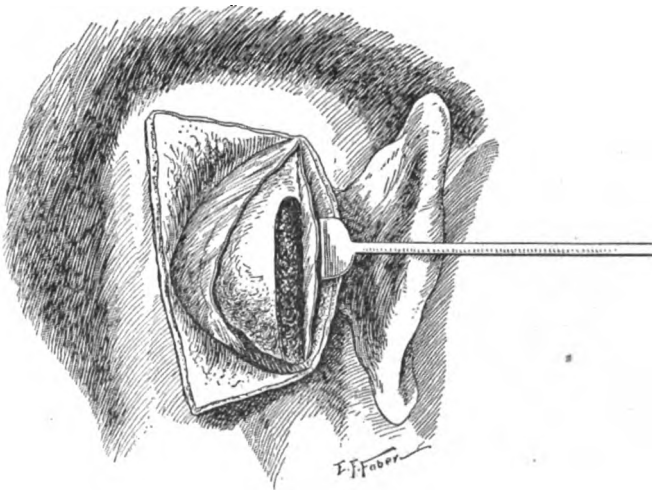


FIG. 3.—The grooved primary chiselling of the cortex of the bone.

the aid of the gouge chisel, should extend only so deep as to expose and open up the superficial cellular structures or diseased and softened bone, the further deepening of the groove being made through the aid of sharp spoons. The primary groove should be gradually deepened by successive shavings of the cortical structures until the cellular structures are entered or until a purulent cavity or softened bone is exposed. When a perforation has already taken place through the cortex, the opening of the cavity and method of its performance is subject to change, according to the size and situation of the external opening.

Frequently with cortical perforation the operation is made with sharp spoons and rongeurs following out the general line as to the form of excavation as given for the average case. Through the use of the sharp spoons the cellular mastoid structures can be readily removed with unerring safety to that depth and extent which is necessary. With the spoon the antrum is exposed. At times the mastoid will be composed almost of diploic tissue, or even of very compact bone, so resistant that the spoon cannot be used, or only under great effort. Under these circumstances it becomes necessary to deepen the groove through the aid of gradually-decreasing narrow gouges. The antrum having been exposed, the groove deepened to healthy bone, and the sinus located, the procedure consists in enlarging the groove in every direction, as

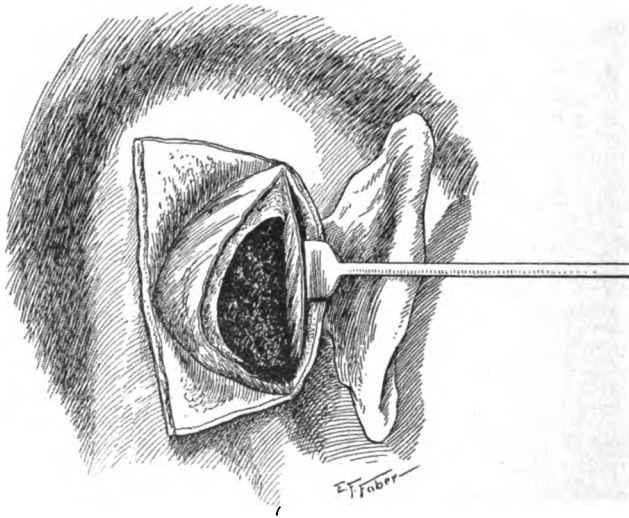


FIG. 4.—The bony cavity enlarged through the use of curettes and rongeurs,

far as to the confines of normal, healthy, non-cellular bone (Fig. 4). It is extremely important to explore and open up pneumatic spaces in the posterior portion of the mastoid, particularly so in those cases in which there is a marked tenderness over the posterior portion of the mastoid.

It has no doubt fallen to the lot of many of you, as it has to me in a number of cases, while following up cells in the posterior portion of the mastoid, with intervening, apparently normal, bony

tissue and somewhat removed from pus-containing cells, to open up one or more large bone cavities, formed by the coalescing of several pneumatic spaces, filled with pus. After having met with this condition one or more times, either through accident or through dogmatic persistency in carrying out a fixed plan of campaign, you have either congratulated yourself on your luck or become more fixed in your resolution to make all your mastoid work more thorough and safe. The extension of the operation from the groove in the posterior and superior direction is made with greater rapidity and more safety through the various forms of rongeur forceps. With the completion of the posterior extension of the bone wound, or even before, as the exigencies of the case may suggest, the tip must be removed in its entirety. In 1896 I operated upon a mastoid abscess, cleaning out a mastoid tip of all the broken-down cellular structures, and leaving the cortex with a cup-like cavity. This patient progressed favorably for three weeks under the care of the attending physician, when I was again called into consultation. My consternation and dismay were great when I found that my patient had a neck filled with an extensive purulent accumulation, which extended nearly down to the clavicle, while the mastoid wound had nearly completely granulated.

At an operation immediately resorted to, the tip was removed and the necessary procedure adopted to evacuate the purulent cavity. In order to safeguard my future mastoid patients from such an unnecessary complication, and to spare myself the future chagrin, shame and embarrassment, I resolved then never to finish an acute mastoid operation without removing the mastoid apophysis, however healthy it might appear. The apophysis is best removed by a large rongeur, one blade of which is inserted under the tip, while the outer blade is made to grasp the external surface. The tip is thus removed in its entirety. If any fibers of tendinous tissues should adhere to the tip on account of want of care in separating them thoroughly during the previous stage of the operation, they should be cut away from the severed bone with scissors before the mass is removed. Under no circumstances should the strands of tendinous tissue be ruthlessly torn away from the muscle. With a small rongeur or sharp spoon the sharp edges of bone should now be removed and smoothed down (Fig. 5).

The mastoid antrum should now be given careful consideration. The communication with the external wound should be enlarged and all granulation therein contained should be curetted away. The bony walls of the antrum should be carefully curetted until healthy bone is reached in all directions. Equal in importance to the removal of the tip of the mastoid and the thorough opening of the mastoid antrum is the exploration and curettage of the zygomatic cells. I believe that this procedure is quite as instrumental in safeguarding the welfare of our patients as the uniform removal of the mastoid apophysis. In several of my cases, although macroscopically the disease process seemed to have expended itself in the body of the mastoid and the antrum, nevertheless have I found, on explora-

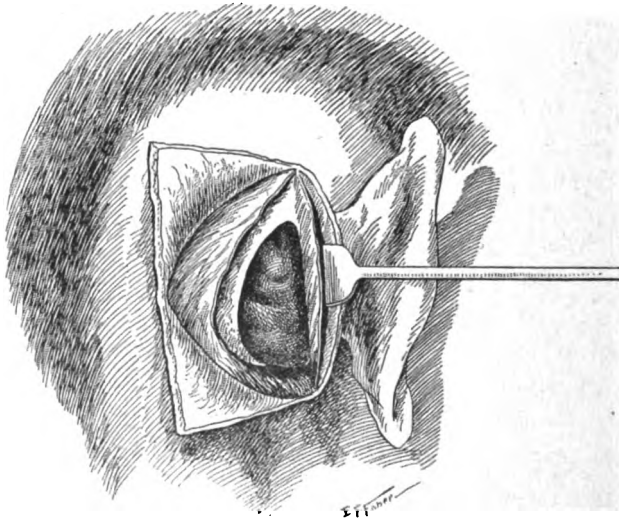


FIG. 5.—The smoothed-out cavity with all carious bone removed, including the tip of the mastoid.

tion of the zygomatic cells, that they were extensively diseased, filled with granulation and pus, requiring rigorous curettment in order to reach healthy osseous tissue.

A recent report of a case in the Archives of Otolgy, by Dr. Brandagee, of New York City, demonstrates how extensive the zygomatic cells are in some individuals and how thoroughly these may become infected. A moderately sharp spoon, used almost on the flat, is now employed to smooth over all rough surface in the bony

cavity made. With a small rongeur all sharp edges of bone on the margin should be snipped off. The cavity is now thoroughly packed with sterile gauze, which is allowed to remain in position for a few minutes. This packing is usually sufficient to stop all oozing and dry out the bony cavity. All small clots and small segments of curetted bone which may have been overlooked during the operation are sought for and removed with dressing forceps and small dull curettes. The bone cavity is again packed with dry gauze and the flaps receive our consideration. Adherent clots should be removed from the cut surfaces of the flaps, any remaining hemostats should be removed, and bleeding vessels which promise to be annoying should be ligated with catgut ligatures.

I never irrigate the fresh wounds with any solution. I have never considered it a display of good common sense, or good surgical judgment, to attempt to wash out the middle ear through the antrum and auditus. I have never adopted such a procedure in any of my cases. The posterior flaps are now replaced, due care being exercised to see that the periosteum is brought well forward with the overlying soft tissues. A couple of silkworm-gut sutures, passing through the soft tissue, and including the periosteum, are sufficient, usually, to unite the cut surfaces of the horizontal wound. I never suture the vertical wound, unless the superior end of the wound has been extended forward in order to reach more conveniently the zygomatic cells, when that portion of the wound passing out of the vertical is sutured. These sutures are placed to prevent a possible sagging of the auricle. I do not suture the ends of the vertical wound, and thus lessen its dimensions, because I know that such a procedure does not lessen the period of healing (Fig. 6). I also know that it gives a narrow opening through which a large cavity must be dressed; that unless great care is exercised in packing up under the flaps they will contract in and thus intensify the cupping of the cicatrix; and that the difficulty of dressing and discomfort to the patient is in proportion to the degree of closure of the vertical wound through the soft tissue. Inversely, with a large opening through the soft tissues the wound can be dressed more comfortably, the cupping of the wound can be controlled to a great extent, and the extension of the skin-grafts from the skin edges can be wholly prevented.



*The Character of the Dressing and how to make its extraction more Comfortable to the Patient.*—During the summer of 1902, while spending a few days in Boston, I had the pleasure of witnessing Dr. Jack do one of his incomparable mastoid operations. In his dressing of the wound, I observed that he used a large-size, thin-wall rubber tubing, which he placed in the wound, and within which he put his gauze packing. Dr. Jack stated that this dressing came away *en masse* at the first dressing without any discomfort to the patient. I was impressed at once with the excellent idea, and later with the thought that fenestrated rubber tissue would subserve the object quite as well and not be so cumbersome. On my return home I instituted the rubber tissue as an additional feature to my

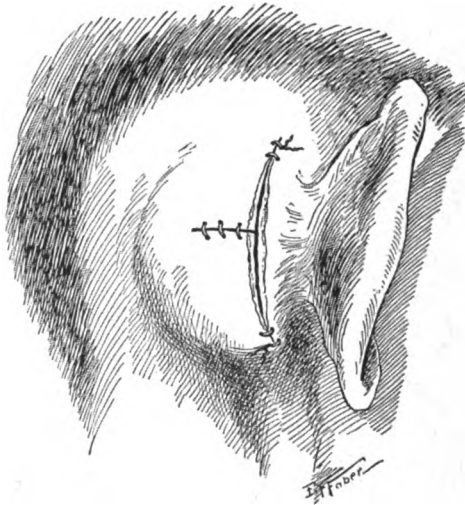


FIG. 6.—The appearance of the wound after the osseous cavity has been packed with gauze and the necessary sutures have been introduced. The wound is now ready for the external dressing.

routine mastoid dressings. At the hospitals in which I serve, the rubber tissue is cut in squares of four to six inches, which are fenestrated. These squares of rubber tissue are always ready. If the rubber tissue is allowed to remain over forty-eight hours in contact with the wound surface, a plastic exudate may form over the whole wound surface. This exudate, when formed, looks rather unpleasant, but I have no reason for believing that it in any way retards the healing of the wound. In order to prevent the

formation of this exudate, when rubber tissue is used in the primary dressing, I should advise the first dressing of the wound to be made within forty-eight hours, not later than after seventy-two hours. Whiting, in his recent excellent work, states that he is the only one, so far as he knows, that has ever made use of the rubber tissue dressing.

I suppose that most of you have already made use of this material in the primary dressing, but, should there be one present who has not done so, I should advise him, in subsequent mastoid dressings, to make use of the rubber-tissue protection and receive the gratitude of his patient. The sterile-gauze packing which we placed in the wound while replacing the flaps and applying sutures to the portions of the wound to be brought in apposition, is now removed. The rubber tissue, which has been immersed in a 1 to 2,000 bichloride solution for many hours, of sufficient size in proportion to the wound, has now placed in its center a small bunch of iodoform gauze, which facilitates the introduction of the tissue into the antrum, and it is now introduced into the wound. The center, containing the small bunch of gauze, is gently carried well into the deepest portion of the wound, and successive layers of iodoform gauze are introduced within the rubber tissue until the cavity is filled out, the rubber tissue being made to rest against the walls of the wound. When the dura or sinus is exposed, this should be first packed off with several layers of iodoform gauze before the rubber tissue and the general iodoform pack is applied. A strip of iodoform gauze may be placed in the auditory canal before the protective dressing is applied.

The usual external pad of iodoform gauze is applied over the wound and the dressing within the cavity, all of which is protected with a pad of sterile gauze and absorbent cotton, the dressings being held in position by aid of a well-applied roller bandage. Our pads are so constructed as to fit snugly behind the auricle, concave along the anterior border so as to coapt closely into the postauricle fold. During the past five years or more we have been rather lax in our dressing of the auditory canal, as I find that, after a complete mastoid operation, with the complete removal of all infective areas, there is no future discharge from the middle ear-cavity into the auditory meatus. The first dressing should be made within seventy-

two hours, when the rubber tissue is employed. In making the first dressing, due care should be exercised in softening down the external dressings before any attempt is made to remove them. The deep dressing should be well soaked and then the iodoform gauze should be carefully lifted out, after which the rubber tissue is removed. All subsequent dressings should be made as the exigencies of the case may demand, and the wound surface may be irrigated or not as the appearance of the wound may indicate. The control of the formation of the granulations is largely in the hands of the dressing surgeon. They may be repressed here and allowed free play there, according as one portion of the wound is packed firmly and the other loosely; or through curettment at one point and stimulation at another, as may be indicated. And so, under proper guidance, the wound is dressed until the wound surface has filled in and cicatrized over. I have never made use of the blood-clot formation with primary closing of the wound; and it would be hardly necessary, except to prevent misunderstanding, to state that I treat the wound as an open one, allowing it to heal throughout by granulation.

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